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ABSTRACT

An experimental program was conducted to develop effective methods for producing and utilizing filmed demonstrations and instructional manuals. Four variations on conventional filmed demonstrations were evaluated: 1) revising an Army film through repeated tryouts with novices, 2) stopping the projector after each step is demonstrated to allow practice of that step, 3) showing the complete film an extra time before practice, and 4) using an animation technique in the introduction. The film variations and a pictorial book program were compared. All methods took roughly the same amount of time to train, if time to show the film is included. Need for assistance can be sharply reduced by using the revised film, or by showing the film one step at a time. An extra showing helps reduce the need for extra time and assistance if the showing is continuous. (Author/JY)

Comparison of Pictorial Techniques for Guiding Performance During Training

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16. Abstract

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The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. HumRRO's mission in work performed under contract with the Department of the Army is to conduct research in the fields of training, motivation, and leadership.

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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FOREWORD

This report describes research performed by the Human Resources Research Organization as part of a basic research effort (BR-14). The objective of Basic Research Study 14, Prompting and Guidance in Training, is to develop effective methods for training men to perform simple everyday Army tasks, such as procedures or the obtaining of reference information, by applying prompting and guidance techniques in experimental training programs. A "prompting" or "guidance" technique is defined as a method of training that puts the learner in a realistic work situation and indicates each required action, one step at a time, as he performs the task. A report of a study of paired-associates (identification) learning, HumRRO Technical Report 70-21, *Prompting and Guessing in Tank Identification*, by Elmo E. Miller was published in December 1970.

The research was initiated while HumRRO was part of The George Washington University. BR-14 research is an outgrowth of HumRRO research performed under Work Unit RECON III, Training Methods and Techniques for Improving Combat Readiness of the Armored Cavalry Platoon, and SHOCKACTION, Evaluation and Improvement of Individual Training for Tank Crewmen.

The research was begun and data collected at HumRRO Division No. 2, Fort Knox, Kentucky, under the supervision of Dr. Norman Willard, and subsequently of Dr. Donald F. Haggard, as Director. Support was provided by the U.S. Army Armor Human Research Unit, with LTC William Q. Harty as Chief of the Unit during the conduct of the research described in this report; LTC J.A. DeAngelis is the present Unit Chief. Work on the research was completed at HumRRO Division No. 5, Fort Bliss, Texas; Dr. Robert D. Baldwin was then Director.

The purpose of the work summarized in this report is to develop effective pictorial techniques for instruction on serial (procedural) tasks. (These pictorial techniques were also adapted and applied in conducting Technical Advisory Service pertaining to the revised Army manual on pistols and revolvers.) The present report is a summary of the results of research comparing various techniques for using sound movies and pictorial books for instruction on the serial (procedural) tasks. The objective was to determine the general characteristics of effective pictorial demonstrations for such tasks, and effective ways of using such materials in training.

HumRRO research is conducted under Army Contract DAHC 19-70-C-0012. Basic Research is conducted under Army Project 2Q061102B74B.

Meredith P. Crawford
President
Human Resources Research Organization

SUMMARY AND CONCLUSIONS

PROBLEM

In training on a manipulative procedure, such as disassembly or assembly of a weapon, it is customary to provide a demonstration of the desired performance in some combination with actual practice of the task. If many men are to be trained, it is generally most efficient to have the demonstration in some standard, pre-packaged form, such as a movie or pictorial book. The research reported here is designed to answer some significant questions that arise in the development and use of such demonstration programs.

The issues studied include (a) whether to develop the program empirically through tryout and revision, (b) whether to have the trainee practice each step immediately after it is demonstrated, (c) whether to give repeated showings of the demonstration, (d) whether to use a movie or a book program, and (e) what principles to follow in producing a demonstration film.

METHOD

An Army training film was condensed to include only the segments that actually demonstrated disassembly and assembly. A revised version of the film was developed by showing it to novices, step by step, as they performed the task, and modifying the portions that viewers found difficult. Both the original and the revised films were adapted for showing either step by step or as a whole. The effect of showing the film twice (rather than only once) before practice was also explored. An optional introduction incorporating the "implosion" technique[1] (as opposed to the standard Army introduction of naming the parts) was also prepared.

These four variables, and all combinations, were compared experimentally in a 2 x 2 x 2 x 2 factorial design to assess their effects and any interaction of these treatments (96 subjects in six replications). Another 48 subjects were run with a comparable pictorial book program which had been developed previously. All subjects practiced until they achieved one perfect trial without assistance.

RESULTS

The data on practice time (to the criterion of one unassisted, error-free trial) show that an extra presentation of the film benefited the subjects who then got another continuous showing (it seemed to save about as much practice time as it took to show the film), but the extra showing seemed a waste of time for the subjects who received the step-by-step presentation. Otherwise all programs seemed to train in roughly the same amount of time, if film-showing time is included.

The data on the number of times the trainees needed assistance show many striking contrasts which are especially important in view of the general shortage of instructors. On the first trial, the number of assists needed was reduced by the use of the revised film, by showing the film step by step, and by an extra showing of the film. (The extra presentation, however, seemed to benefit only those subjects who got another continuous

[1] A movie technique in which the parts appear to pop suddenly into place, one at a time, to form the completed assembly.

showing, but not those who saw a step-by-step presentation; the same pattern was also found in the practice time data.) The special imploded introduction did not produce any advantage over the standard Army introduction on either the time or assists criterion.

On subsequent trials, the step-by-step viewing resulted in significantly more assists (a reversal of the first trial trends), although the subjects did not fall back to the level of first trial performance of subjects who viewed the film continuously. The revised film continued to show a significant advantage over the Army film. The extra showing did not produce a significant difference in number of assists.

For subjects who received the book treatment, the number of assists was roughly comparable to the average for subjects who saw the Army film, but significantly higher than for subjects who saw the revised film.

The changes made in producing the revised film entail many principles for such films, and these principles were organized into a coherent set.

CONCLUSIONS

(1) The reliability of communication of a demonstration film may be increased appreciably by careful tryouts with novices and subsequent film revision. In a revision, the thoroughness that may be warranted will depend on how many trainees are expected, and other situational factors.

(2) When students see a film one step at a time as they perform the task, they require fewer assists on the first trial than students who see the film without interruption, yet on the second trial they need more assists (as the step-by-step guidance is withdrawn) than those who have had no such guidance. There is thus no evidence that such guidance (when assistance is available) saves time, and certain factors inherent in the guidance method place a limit on how rapidly a person can demonstrate mastery.

(3) The revised film, shown step by step, virtually eliminates the need for assists on the first trial. Thereafter, by appropriate methods of showing the film, assistance may be kept to a minimum.

(4) If the continuous viewing method is chosen in a situation where step-by-step viewing is considered especially awkward, an extra showing of the film at the start is likely to be worthwhile, in terms of both time and assists. (This is *not* true for step-by-step viewing.) If the film is developed like the revised one in the present program, many trainees will need no assists at all, especially if the film is shown twice.

(5) The pictorial book program does a very creditable training job, despite its lack of audio and its inability to represent motion; it was roughly comparable to the movie programs in time required, and comparable to the Army program in number of assists (but requiring significantly more assists than the revised film program).

(6) Developing a film through tryouts and revisions is promising as a research method, and in this experiment the development of the revised film yielded a coherent set of principles for producing demonstration films.

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INTRODUCTION

For most soldiers, many daily tasks involve rather simple procedures or responses. For example, they might have to assemble or disassemble their weapons, or be required to fill out standard Department of the Army printed forms. The required responses are simple enough that even a novice can respond correctly *if* each step is demonstrated just before he performs it. For efficient training on such tasks, the *guidance* method is especially promising. The guidance method consists in *putting the man in a realistic work situation, and indicating the required responses, one step at a time, as he performs his task.* This report is concerned with the efficiency of various forms of guided practice.

RELEVANCE OF PRACTICE ACTIVITIES

Many formal studies, as well as common observation, indicate the effectiveness of *guided learning* for many kinds of tasks, (e.g., see references 1 through 12 under Literature Cited). Perhaps the most arresting feature of the guided learning method is that the practice activity is a direct execution of the required job performance—a striking contrast to the high degree of job irrelevance so commonly found in training courses.

The relevance of practice under *programed instruction,*[1] with its careful analysis of instructional objectives (13, 14, 15), explains a large share of its commonly found superiority over conventional teaching methods. Yet even compared with a carefully developed linear program, Shettel and Lindley (16) found that students could learn the phonetic alphabet (a=alpha, b=bravo, etc.) in about one-third the time through a self-administered drill with little booklets merely containing the pairs to be associated. Such booklets, like flash cards, can be considered a guidance method applied to paired-associates tasks.[2] However, in order to benefit from using the guided learning technique, one must determine the kinds of tasks for which it is appropriate, and the sort of guided learning which is most likely to be effective.

APPROPRIATE KINDS OF TASKS

Tasks that are structured around equipment, devices, or some other special environment are especially good candidates for guided learning, as might be inferred from the phrase, "in a realistic work situation," in the definition of the guidance method. The realistic work situation offers two kinds of advantages: (a) The actions can be practiced with respect to an appropriate stimulus structure; and (b) manipulation of the equipment

[1] For present purposes, *programed instruction* may be defined as instruction based on careful analysis of objectives, active practice of the behavior specified by the objectives, and repeated revisions on the basis of careful tryouts with representative students. Although guided learning, if carefully developed, might thus qualify as programed instruction, the term "programed instruction" has generally referred to a broader area including more abstract or classroom-type courses.

[2] The term *guided learning* is generally reserved for serial or procedural tasks, as might be inferred from the phrase *step by step* in its definition. With paired-associates or *nomenclature* tasks, the term *prompting* is more generally applied. However, both terms involve indicating or telling the correct response before the student has an opportunity to guess.

may reveal critical task characteristics (response-produced cues) that would not otherwise be apparent to the student. The importance of the first factor was demonstrated by Miller (6) by providing procedural checklists to presolo flight students to guide their practice. Miller found that students who practiced in a cockpit mockups made only about half as many procedural errors in their subsequent presolo flights as students who practiced in ordinary chairs. (The errors were as noted by the flight instructors in their flight logs.) Others have found that the rather low fidelity of such stimulus structure does not seem to degrade effectiveness of practice (17,[1] 18, 19,[2]).[3]

Presumably, a somewhat higher level of equipment fidelity would be needed if manipulation were to reveal significant equipment characteristics (advantage "b"). For instance, in learning to assemble or disassemble a weapon, and to see how it works, subjects would want to practice with the equipment rather than with photographs alone, because the equipment is necessary in order to get the feel of spring pressures, latches, detents, and so forth, or perhaps to look at a part from a viewpoint not shown in a photo (both procedures involving responses producing cues which otherwise are not available).

On the other hand, tasks that do not involve critical environmental features, or that entail critical conceptual components, may not be readily amenable to simple guidance of the overt actions. Thus, Weiss, *et al.* (20), employing a geometric construction task, compared the efficiency of demonstrating the whole task (followed by practice) with various strategies of guided practice (employing smaller units of demonstration-practice). They found, unexpectedly, that the guidance strategies did not lead to any clear or reliable superiority of test performance, even though guidance did lead to superior performance during practice—that is, guidance enabled students to make more nearly perfect drawings during practice, but this superiority did not result in better subsequent test performance.

Weiss, *et al.* concluded that the task was not the sort to which their theory (various forms of the general guidance concept) applied. Their tentative explanation was that the task was complex not in the sense of being a long chain of separable acts, but it was *conceptually* complex in that each step was dependent on anticipation of subsequent steps, rather than on external cues from the environment. In conceptual tasks, the overt behavior which is guided may thus be trivial if it is not accompanied by the conceptual content.

PROMPTING VS. TRIAL AND ERROR

Several experiments on programed instruction were investigations of the effectiveness of *prompting*, defined as indicating to the subject the correct response before he has an opportunity to respond. Although such prompting experiments have generally been conducted with paired-associates tasks, the results should also be related somewhat to the guided learning technique and in this report the term *prompt* will be extended to include the indication of the desired response in procedural tasks. A number of experiments have shown superiority of prompting responses over trial and error learning (21, 22, 23, 24), especially during early trials (25). Cook and Spitzer (26) found that forcing a student to

[1] Work Unit RINGER, Fidelity Requirements for Training Devices, HumRRO Technical Report 65-4.

[2] Work Unit STRANGER, Long Term Memory of Motor Skills, HumRRO Technical Report 69-1.

[3] Similar results were obtained by Wallace W. Prophet, and H. Alton Boyd of HumRRO Division No. 6 (Aviation) in a study of the relative effectiveness of Device 2-C-9 and a photographic cockpit mock-up device in teaching ground cockpit procedures for the AO-1 Aircraft, under Work Unit TRADER, Developing Guidance for Establishing Requirements and Characteristics of Training Devices, in June 1962.

guess actually interferes with learning; apparently incorrect guesses lead to formation of incorrect associations. Yet there seems to be some advantage in responding without prompts.

Angell and Lumsdaine (27) report an experiment in which they prompt three-fourths of the responses, and they find this procedure superior to continuous prompting. These trends seem to indicate that learning with prompts will be relatively efficient, compared with trial and error, in tasks where the student population is unlikely to discover the right responses, or when they are especially likely to make errors. Thus, prompted responses are apt to constitute more efficient practice than trial and error when (a) the associations are arbitrary, or (b) the equipment is so complex as to make the associations seem arbitrary, or (c) subjects do not have the component skills and their attempts are for this reason unlikely to be successful and they are unlikely to understand their errors, or (d) the consequences of error are severe, as in dangerous tasks. (Annett and his associates, 28, 29, 30, have noted a relatively bold response tendency in their unprompted subjects during discrimination learning.)

However, in reasoning tasks, such as decision making, one has time to consider incorrect alternatives, and recognizing them as wrong in the particular situation may be expected to lead to more reliable discrimination of the correct choice. Pressey (31) has long been an advocate of using plausible, often-chosen, wrong answer choices in developing discrimination in conceptual material.

Size of Unit Prompted

If prompts are to be used to guide performance in procedural tasks, the size of each demonstration practice unit must be established. Generally, demonstrating the whole performance to students before they begin practice has been found less efficient than prompting (by demonstrating) somewhat smaller segments (8, 4, 1, 3, 32). Comparatively short units are prompted when one supposes that parts of longer demonstrations are apt to be forgotten before practice begins. Demonstrations of whole tasks, or of segments too long to be remembered, are apt to lead to the same kinds of inefficiencies as trial and error learning, but to a somewhat lesser degree (to the extent that some parts are remembered).

One might expect the most effective unit to be the longest demonstration a student could be exposed to before his ability to reproduce it was degraded, which Sheffield and his associates call the demonstration-apprehension (D-A) span (4, 8). Of course, the D-A span varies with individuals. Margolius and Sheffield found that poorer learners, as indicated by final test scores, chose shorter demonstration segments before practice; similarly, Gropper (33) found a significant interaction between IQ and optimal length of demonstration unit. Also, tasks are not divisible without limit, but have natural units; the finest division is almost always somewhat smaller than the D-A span (4, 8). Perhaps related to the optimal length of the D-A span are findings of Margolius, *et al.* (5), who found it more effective to have students practice each unit *twice* before going on to practice the next unit, rather than practicing the complete performance in sequence twice.

Certain Practical Considerations

In practice, however, the optimum length of demonstration is apt to depend upon a conglomeration of classroom variables which might be termed *logistic* (e.g., student-instructor ratio), and these variables are indeed pertinent to the experiment reported here. It is not merely that these classroom variables have an effect, but that some kinds of deviation from the optimum are apt to be much more crucial than others.

For instance, with a minimum of instructors, it is better to somewhat overprompt than to underprompt, since failure to give a needed prompt is apt to leave a student at a loss until an instructor is available, while giving too many prompts will reduce efficiency of practice only slightly. The effects of overprompting may be further reduced by allowing a subject to control or ignore the prompts, or to anticipate (perform in advance of) the prompts so that they serve merely as confirmation.

These considerations are important in terms of the fact that, in designing practical training courses, one attempts not only to approximate optimum conditions, but especially to avoid the gross inefficiencies so common in training courses.

Properties of Prompts

Although sometimes verbal prompts are sufficient (e.g., 6), the most widely used form of guidance is a demonstration (or demonstration film), accompanied by a narrative. Many production features of demonstration films have been shown to increase the effectiveness of practice. One should allow time for responding (24, 34, 35). The student's attention may be directed to the relevant task cues by testing (36, 37, 38, 39, 40) or by animation (arrows, etc., 41) while avoiding embellishments that are irrelevant (42). Instructional narrative can aid instruction (34, 43, 44, 45), as can motion (46) and slow motion (35). The camera angle should represent the learner's point of view (46). Since there is evidence to suggest that the hands of the demonstrator may sometimes tend to obscure critical cues (46), special care should be taken by the demonstrator.

One may increase perceptual vividness (47) using camera techniques. One especially promising means of making vivid the relationship among various parts of the equipment is the *implosion* technique (48), used to teach assembly. This technique consists of a series of stills, presented so that the parts appear to pop into place, thus, it is a dynamic reconstruction from an exploded view of a system. The *implosion* technique is involved in the experiment to be reported here. The experiment also concerns the repetition of a demonstration, which has also been found effective in other experiments (49, 50, 51, 52).

Media for Prompting

The relative advantages of different media for prompting, say movie vs. book, may depend not only on the effectiveness of the stimuli, but also on logistic factors of the sort mentioned earlier. The natural advantage of the realistic motion stimuli in a movie might be offset by the fact that in a book the learner is free to look back over pictures and instruction. Also, with a book one is not forced to view a demonstration for a fixed period, and it is easier to adapt the book presentation to individual rate differences. Also, a book may be available for review or even guidance on the job (as in equipment maintenance), which might be more difficult or impossible with other media.

PROGRAM DEVELOPMENT

A significant feature of programed learning is development of programs through several cycles of tryout and revision with novice learners, and Gropper has demonstrated the value of such empirical development for visual demonstrations (53, 54, 55, 56). The process should be useful, not only for developing particular programs, but also in developing the general principles of our training technology, if we note the changes made and the reasons for making them. When the demonstrations are for very short natural units, failure to perform a step is hardly attributable to simple forgetting, but rather to a failure of communication; even hesitations may give some clue as to possible improvements. This kind of evidence is likely to be very sensitive to subtleties of technique, and it seems to be a promising research method.

The reasons for making particular changes are apt to recur during program development, and may be organized into a coherent rationale. Although a principle may be confirmed only weakly by any particular instance of change, the evidence from several varied instances may be considered somewhat stronger, especially when the principles are interrelated in a nomological net, that is, a systematic set of principles (the classic method for scientific theory, 57, p. 290). Also, problems which actually arise are more apt to be a representative sample of future difficulties than problems formulated on an *a priori* basis.

PURPOSE AND HYPOTHESIS

The experiment described in this report was conducted in order to establish some effective general methods for developing and using demonstration materials—film or book—for procedural tasks. An effective film (or book) is one that yields mastery of the task in minimal training time, and with minimum assistance from instructors; thus, the criteria of effectiveness were (a) the amount of training time spent on it, and (b) the number of assists given during training.

The major experimental variables correspond to some general hypotheses about practices which seem likely to reduce training time or amount of assistance:

Hypothesis 1: Having the trainee practice each step immediately after it is demonstrated, rather than after the complete demonstration, will reduce training time or number of assists, or both.

Hypothesis 2: Revising the film on the basis of student performance will subsequently reduce training time or need for assists, or both.

Hypothesis 3: Showing the film twice (instead of only once) will reduce training time or need for assists, or both, and such an effect may depend upon the other treatments given (with respect to hypotheses 1 and 2).

Hypothesis 4: Use of the *implosion* technique in presenting the various component groups will yield better perceptual organization and thus reduce training time or assists, or both.

Hypothesis 5: The effectiveness of a picture guide book will be close enough to the movie to be appropriate for many training situations.

METHOD

A complex factorial experiment was conducted to compare the efficiency of various methods of instruction on disassembly/assembly of the M-73 machine gun. The instructional variations included various ways of instruction by sound movies, and a pictorial programed book.

DEMONSTRATION FILMS

Army Film. From an official Army training film on the M-73 machine gun, the portions which actually demonstrated the general disassembly and assembly on the weapon were extracted and spliced in sequence. This condensed version of the film is much more directly relevant to the soldier's immediate performance than the uncondensed version under ordinary viewing conditions, and is part of a general series of films on the M-73, most of which is not directly related to actions required of the soldier.

Revised Film. During exploratory experimentation the film was tested on novice soldiers, various shortcomings became apparent, in spite of the fact that the film was chosen because it had seemed especially clear and effective. (The changes are discussed in detail in the last section of this report.) Some of the shortcomings were violations of classic principles of demonstration films (e.g., the camera angle should be from subjective, i.e., over-the-shoulder, viewpoint, 46).

A revised film was developed through several cycles of trial and revision with novices, for experimental comparison with the original Army film, to determine the extent of improvement, and to document the kinds of changes which underlie the final version.

VIEWING METHODS

Interspersing Practice. Each version of the film was prepared for viewing two ways: continuously, with practice on the weapon only after the complete film had been viewed; and step by step, with practice of each step on the weapon immediately after the step had been viewed. In relation to past standards (4, 8), these would be considered very small natural units, 28 steps in the film. The extreme smallness of steps facilitated the development of the revised film. With such small steps, any mistakes or even hesitations could be attributed to ineffective communication, since simple forgetting could be ruled out.

Repeated Viewing. It seemed reasonable that an extra viewing of the whole demonstration film at the start might be worthwhile, and that the effects of such repetition might depend on the other treatments given—that is, an interaction effect. Consequently, each of the two viewing methods was subdivided into one viewing and two viewings. The schema for these treatments is illustrated in Figure 1.

All subjects who viewed the film twice first viewed the film without interruption; subsequently, the continuous viewing subgroup again viewed the film without interruption, and the step by step subgroup practiced each step right after he viewed that step.

TYPE OF INTRODUCTION

Because of the promise of the implosion technique (48), alternative introductions were prepared, each lasting two minutes. In the Army version, the parts were grouped on a display board, with a title printed under each group (e.g., the receiver group), and the camera panned around the board as each part and each group was named on the audio channel. In the imploded version, an animation technique was employed so that the groups would appear to slide out abruptly, then fall into their component parts; each group and its parts would be named on the audio channel, and the printed group title would appear at the appropriate time. After the weapon was thus disassembled, the process was reversed, with the parts falling together to form groups, and the groups popping back into place on the weapon.

PICTORIAL PROGRAMED BOOK

A pictorial book, designed for the same task, was evaluated in comparison with the various film treatments. Ware and Constantinides (58) have described this book which, Schema of Film Viewing and Practice

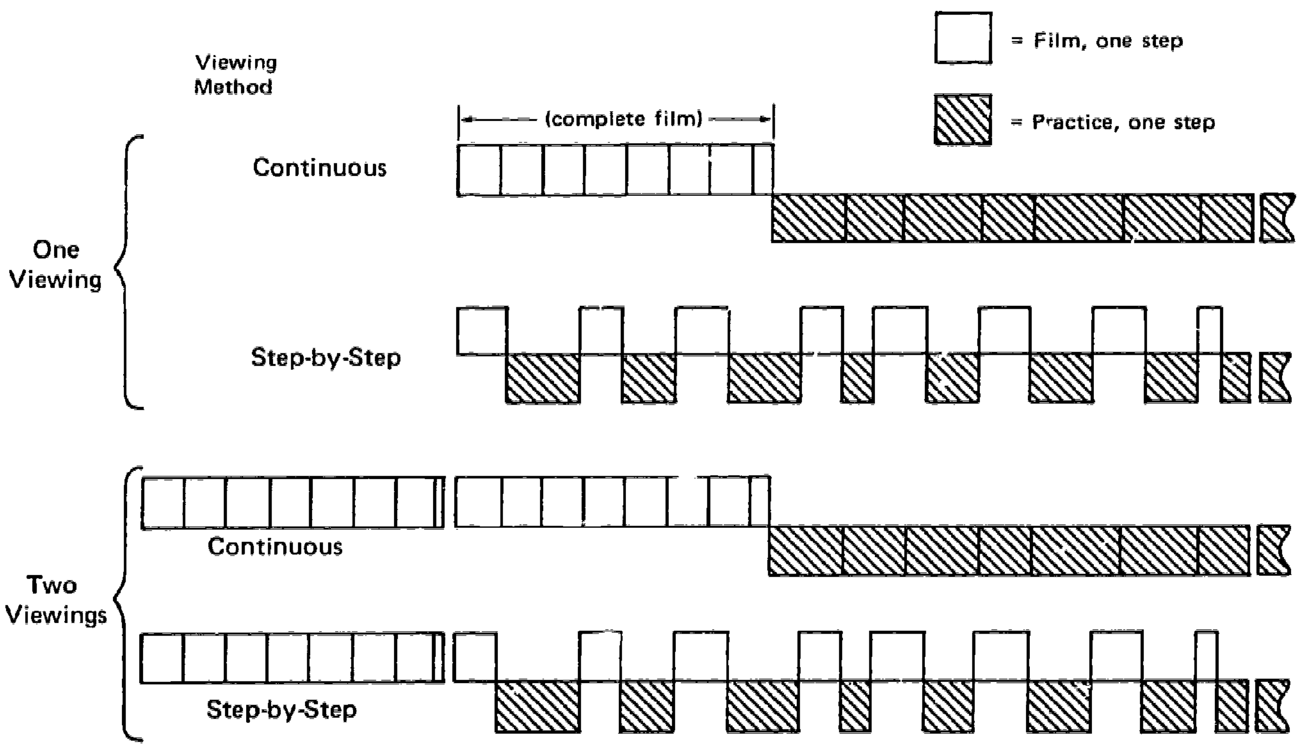

Figure 1

like the revised film, was developed by testing with trainees. The subjects under the book condition were all run under the same procedure.

EXPERIMENTAL DESIGN

Thus, we have a 2 x 2 x 2 x 2 factorial design for the film treatments: Army vs. revised film, step-by-step vs. continuous viewing, one viewing vs. two viewings, Army introduction vs. imploded introduction.

In six replications, 96 subjects were run individually under the 16 film conditions. In addition, 48 other subjects were run individually using the pictorial programed book which covered the same task (58), to provide a media comparison for each of the two versions of the film. Although the book was developed by tryouts with novices, its development probably was not so extensive as that of the revised film. The experimental design is illustrated in Figure 2.

SUBJECTS

The 144 subjects were basic trainees who had no experience with the weapon; they were assigned at random within each replication. A stack of 24 cards was prepared, each card listing the conditions of one cell of the experimental design (16 cells for the film, 8 for the book), and the cards were drawn at random to determine the condition for training each subject.

Number of Subjects Run Under Various Conditions

	Viewing Method	Army Film: Army Introduction	Army Film: Imploded Introduction	Revised Film: Army Introduction	Revised Film: Imploded Introduction	Subjects
One Viewing	Continuous	6	6	6	6	24
	Step-by-Step	6	6	6	6	24
Two Viewings	Continuous	6	6	6	6	24
	Step-by-Step	6	6	6	6	24
	Total	24	24	24	24	96
Pictorial Programed Book						48

Figure 2

The subjects in an Army manpower pool vary over time periods (e.g., during June and July a disproportionate number of college graduates may be drafted and are therefore apt to be in the pool). The replications (i.e., one subject for each of the 24 treatment combinations constituted a single replication) were run successively so that the variation among replication means could be tested to see whether some time-related factor was indeed significant.

If for any reason a subject was eliminated from the experiment, he was replaced by the next man to be run. Five of the early subjects were eliminated because of misunderstanding between the experimenter and the Work Unit leader on experimental procedures. Three subjects were replaced because of equipment failures.

APPARATUS

The subjects were run individually in a room arranged as in Figure 3. An M-73 machine gun was in front of the subject, its receiver group bolted to the table to facilitate the task. An indirect light (7½ watt) was built into the table so that the subject could distinguish the *S* and *F* stamped onto the backplate. There was room on the table for laying out the parts as in the demonstration.

Under the film conditions the subject viewed the movie on the rear projection screen (image size approximately 31 x 42 inches). Under the step-by-step film conditions, two seconds (48 frames) of black leader were spliced between steps; the leader was the experimenter's signal to turn off the projector (from a button on his console). Except for the black leader, the films for continuous and step-by-step treatments were identical for otherwise comparable groups.

As the subject finished practicing each step, he would press the green button to start the projector for the next step. Three standard Army 16mm sound movie projectors were used, No. 3 for the introduction, No. 1 for disassembly, and No. 2 for assembly. Projectors 1 and 2 had a special feature in that while one projector was in use, the other would be rewinding. At the end of the film, a spring contact would sense a notch in the side of the film that stopped the projector automatically. Thus, the demonstration could be shown repeatedly without delay.

Arrangement of Experimental Room and Equipment

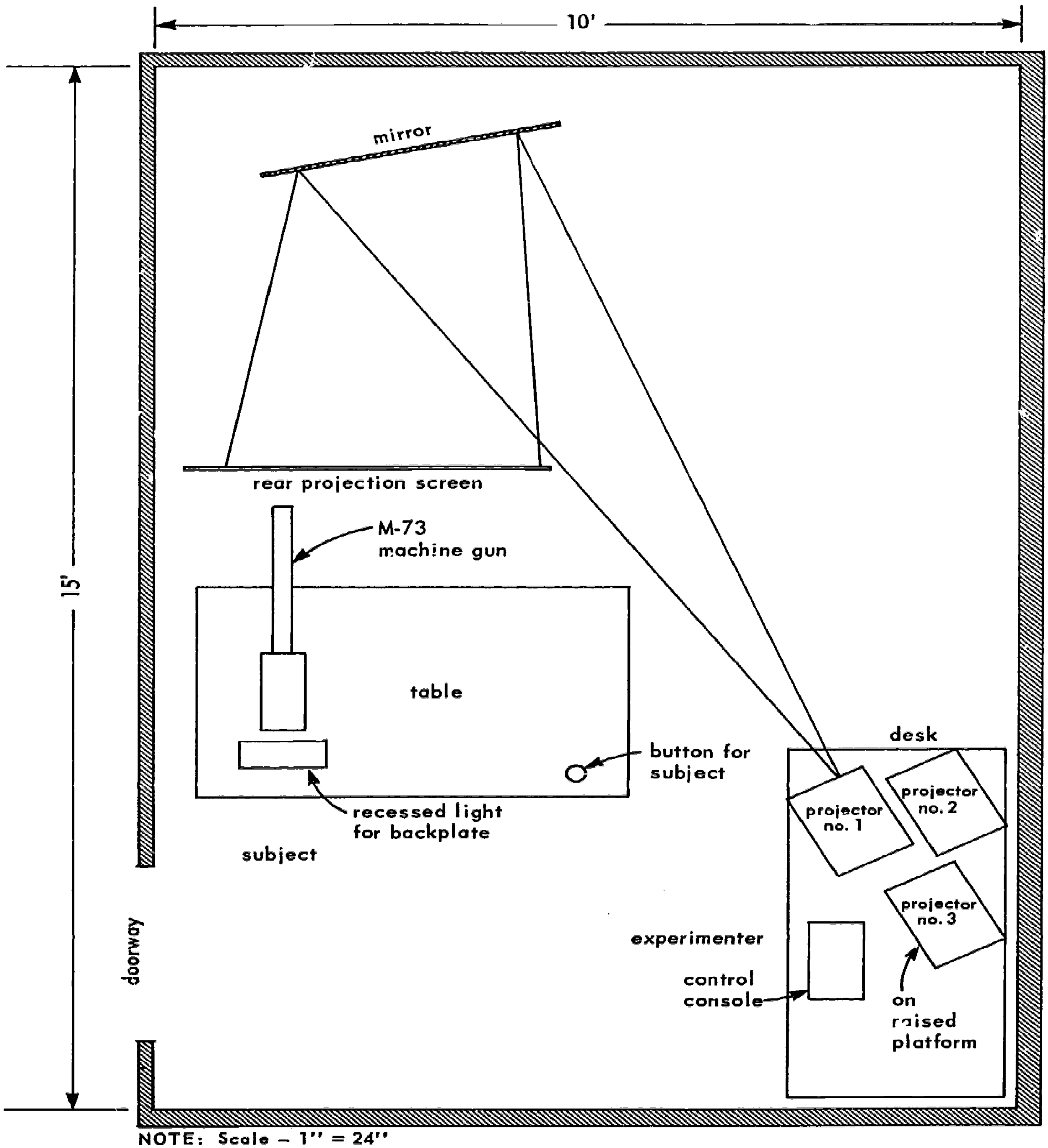

Figure 3

The experimenter could control the projectors from his console, which was especially arranged and labeled for the purpose. He also controlled a marker pen for an Esterline Angus[1] event recorder; another Esterline pen recorded automatically the fact that a projector was in use.

Three ceiling lights controlled by a dimmer switch provided general room illumination, which was left at a moderate level for all conditions, since the projectors were bright enough (750 watt bulbs) to project a clear image in the lighted room.

The same general circumstances applied to the book condition, except that the projectors were not in use and the pictorial programed book was provided.

PROCEDURE

Rather extensive but informal exploratory experimentation was conducted: (a) to develop the revised film, (b) to develop the special performance recording forms, and (c) to develop and practice the introductory remarks and experimental procedure. All subjects were run by one experimenter, who also helped to develop the procedure.

Special performance recording forms were developed. The version of the form for use with the Army film is presented in Appendix A; for the revised film and book treatments, comparable forms were also prepared, modified slightly according to the differences in the treatments. Using these forms, the experimenter could record errors or the need for assistance by checking an appropriate item, and later write in the performance time for each step.

The brief introductory remarks and instructions, though not memorized exactly, were substantially as given in Appendix B. When instruction began for subjects in the film groups, they first saw a two-minute introductory film, as described earlier in "Type of Introduction." Then the subjects who were to view the film twice would view the whole disassembly/assembly film demonstration without interruption; then (a) the subjects in the subgroups who were to view it continuously would have a second uninterrupted viewing, then their first practice trial, and (b) the subjects in the subgroups who were to view it step by step would have another viewing, interrupted for practice of each step, which constituted the first practice trial. The subjects who were to view the film once would view it continuously or step by step (see Figure 1). With the book treatment subjects did not see any film and used the book on their practice trial.

After the first practice trial, subsequent trials were run under test conditions (without the film, but with assists as required). Under the book conditions, however, if the subject needed an assist (as defined later) he was allowed to continue using the book for that trial, since after his assist it would be impossible for him to meet the criterion on that trial. This practice seemed closest to normal classroom conditions, since the book can be managed on an individual basis, while movies are generally shown to the whole group.

During all trials, the experimenter provided correction or assistance only when the subject's performance indicated a need for such help, after which the experimenter would check the corresponding item on the recording form. The contingencies for providing correction or aid were as follows: If the subject began to do something dangerous, or directly asked for help, an assist was provided immediately. If he was looking at or manipulating something relevant, something which might eventually lead to success, a rather long interval of several seconds would be allowed before the experimenter intervened. But if the subject were looking at or manipulating something irrelevant, or if he

[1] Identification of this product is for research documentation purposes only; this listing does not constitute an official endorsement by either HumRRO or the Department of the Army.

apparently gave up, only a few seconds would be allowed. It seemed that these standards were easy to follow in practice, with rather high agreement between observers on particular cases, and a rigid procedure with a stopwatch seemed needlessly clumsy. The subjects did not seem to seek unnecessary help, since their objective was to perform the whole task without error and without aid, after which they would be released from the experiment.

After the first three replications were run, a minor change was introduced because it appeared arguable that step-by-step viewing entails a somewhat spurious disadvantage compared with continuous viewing; unlike continuous viewing, step-by-step viewing does not permit the subject to meet criterion on his first trial. In fact, in the first three replications, the criterion had been met on the first trial by eight of the 24 subjects who viewed the film continuously. On the other hand, it might be argued that such a disadvantage is intrinsic to step-by-step viewing, and that whatever the subject's real state of knowledge during the first trial, there is no practical classroom technique under step-by-step viewing for finding the high-skill subjects and dismissing them after the first trial. Since the point is debatable, during the last three replications all subjects had to undergo at least two trials, so that there would be a basis for comparison of the times required under the two conditions.

RESULTS ON MAJOR VARIABLES

TIME TO REACH CRITERION

Table 1 presents the analysis of variance of various film treatments in terms of the total practice time (in seconds) required to reach the criterion of one perfect trial without an assist. Only performance time is involved, not time required to show the films.

To obtain a pooled error term, the residual variance was adjusted by compensating for differences among replication means, which might reflect the varying sources from which the subject population was drawn. The interactions with replications thus constitute the pooled error term; if these interactions entailed appreciable effects besides experimental error, they would tend to bias the *F* tests toward nonsignificant results. The overall effect of replications was not significant.

Statistical significance ($p<.01$) was obtained for the BxC interaction (number of viewings X viewing method). Table 2 shows the pattern of means underlying the BxC interaction, and the significance of the apparent pattern is definitely confirmed by analysis of variance of the simple effects: viewing the film twice (rather than only once) is of significant help for those who get a continuous viewing, but does not help those who get a step-by-step viewing with practice interspersed. The average of these simple effects constitutes the overall effect of C (one vs. two viewings), which was also significant.

Analysis of the simple effects on the other dimension reveals that, if the film is viewed only once, the step-by-step viewing group learned somewhat faster, but the effect is not statistically significant. If the film is viewed twice, the step-by-step viewing group took significantly *more* time to learn ($p<.01$). Procedures for these analyses are given by Winer (58, pp. 174-178, 213-215, 230-238).

To take account of the time required for an extra film showing, one would add 370 seconds for the Army film, 470 seconds for the revised film, or an average of 420 seconds. (The introduction took an extra 120 seconds for all film treatments.)

Thus, for the continuous viewing treatment, the extra viewing appears to save about as much practice time as it takes to watch the film. But for the step-by-step viewing

Table 1

Analysis of Variance: Total Performance Times Required to Reach One Perfect Trial[a]

	Source	df	MS	F
A	Version of Film	1	65,573	<1
B	Viewing Method	1	184,713	1.50
C	Number of Viewings	1	1,041,458	8.48**
D	Type of Introduction	1	124,056	1.01
	Replications	5	125,701	1.02
AB		1	233,938	1.90
AC		1	219,746	1.79
AD		1	7,089	<1
BC		1	1,178,158	9.59**
BD		1	97,473	<1
CD		1	10,395	<1
ABC		1	51,661	<1
ABD		1	658,856	5.36*
ACD		1	84,668	<1
BCD		1	8,306	<1
ABCD		1	52,313	<1
Pooled error		75	122,870	

Book Program vs. Army Film $t = 9.77$**
Book Program vs. Revised Film $t = 10.40$**

[a]**indicates statistical significance at the .01 level.
*indicates statistical significance at the .05 level.

Table 2

Mean Times for the Significant BxC Interaction[a] in Viewing Film

			B: Step-by-Step Viewing		B: Continuous Viewing		
One Viewing	C	(1)	974.5	(3)	1108.3	(2)	1041.4
Two Viewings	C		987.7	(4)	678.4		833.1
			981.1		893.4		937.2

Significance of simple effects:

(1) NS
(2) <.01
(3) NS
(4) <.01

[a]Number of Viewings (C) x Viewing Method (B).

treatment, the extra viewing takes time without appreciably reducing required practice time.

The difference between film versions favored the revised film slightly, but the difference was not significant. The mean difference between types of introduction was not significant statistically; in fact, the actual difference tended to favor the Army introduction. The ABD interaction is statistically significant ($p<.05$), and there seems to be no obvious explanation. The pattern of means is given in Table 3.

Table 3

Mean Times for the Significant AxBxD Interaction[a] in Viewing Film

				A_1 Army Film	A_2 Revised Film	
B_1	Step-by-Step Viewing	D_1	Standard Introduction	978.3	975.8	977.0
		D_2	Imploded Introduction	1134.9	835.4	985.2
B_2	Continuous Viewing	D_1	Standard Introduction	893.8	757.3	825.5
		D_2	Imploded Introduction	846.5	1075.8	961.2
				963.4	911.1	

[a]Version of Film (A) x Viewing Method (B) x Type of Introduction (D).

Both film versions (Army and revised) required much less *practice* time than the book program, and each of the differences is statistically significant ($p<.01$, based upon a t test in which the variance estimate for the two film treatments was calculated from the pooled error term). If the showing time of the film is added to the overt practice times, the differences virtually disappear (and are not significant statistically).

No analysis for the part-task time scores was attempted, because of the lack of significance on the major dimensions for which a subtask analysis might be relevant.

"ASSISTANCE" TALLIES

Tables 4 and 5 list the number of assists given to various treatment conditions. The "introductory treatment" variables (concerned with the implosion technique) showed no consistent trends. For formal statistical tests, the data in Tables 4 and 5 must be in the form of distributions. (Data for forming these distributions are in Appendices C and D.) The statistical tests used are likely to be on the conservative side, in that any effects attributable to one dimension of the experimental design will tend to obscure the effects attributable to the other dimensions.

On the first trial, step-by-step viewing sharply reduces the number of assists needed (Mann-Whitney U test, $p<.001$). The revised film also sharply reduces assists on the first trial (Mann-Whitney U test, $p<.001$), and among subjects who viewed the revised film step by step there was almost no need for assistance:

Table 4

Errors or Assists on First Trial

Viewing Method: Step-by-Step vs. Continuous Viewing	Film Version: Army	vs. Revised	Total
Continuous Viewing	59 (once) +31 (twice) = 90	55 (once) +10 (twice) = 65	155
Step-by-Step Viewing	18 (once) +21 (twice) = 39	3 (once) +1 (twice) = 4	43
	129	69	198

Table 5

Errors or Assists After First Trial

Viewing Method: Step-by-Step vs. Continuous Viewing	Film Version: Army	vs. Revised	Total
Continuous Viewing	4 (once) +1 (twice) = 5	2 (once) +0 (twice) = 2	7
Step-by-Step Viewing	11 (once) +17 (twice) = 28	14 (once) +12 (twice) = 26	54
	33	28	61

An extra viewing of the film also reduced assists significantly (Mann-Whitney *U* test, $p<.02$), but as shown in Table 4, the apparent benefits from the extra viewing are due entirely to the differences within the groups who viewed continuously; this pattern is, of course, the same as that found in the practice time data presented above. The difference associated with type of introduction, which slightly favors the Army introduction (as did the practice time data), was not significant. (Mann-Whitney *U* test falls just short of the .05 level with a two-tail test.) The book treatment, compared with the conglomerate of the Army film treatments, had no significant effect on first trial assists, but when compared with the revised film treatments, required significantly more assists (Mann-Whitney *U* test, $p<.001$).

On second trials, there were so many cases of zero assists that the Mann-Whitney *U* tests were replaced by χ^2 tests (59, p. 231) using the categories "zero" vs. "more than zero" assists. (No subject in any film treatment group needed assists after the second trial.) On the second trial, there was a sharp reversal of the trend of assist data associated with viewing method; although the step-by-step presentation resulted in fewer assists on the first trial than continuous viewing, step-by-step viewing resulted in significantly more assists on the second trial when the prompts were withdrawn ($p<.001$). However, the first trial with step-by-step viewing resulted in some learning, since these subjects performed better on their second trial than the continuous viewing subjects had done on their first trial (Mann-Whitney U test, $p<.001$).

The revised film on the second trial shows a small (but not statistically significant) advantage over the Army film. The lack of significance is not surprising in view of the heavy concentration of zero assists in both groups. The two viewings condition yields means virtually identical to those of the one viewing condition. This result is consistent with the other trends on this variable, since the trends consisted of differences within the continuous viewing group, few of whom required any assists at all on the second trial. Type of introduction did not result in significant differences.

After the first trial the book treatment is associated with somewhat more assists than the Army film conditions, but the difference is not significant statistically. The book treatment does result in significantly more assists than the revised film conditions (χ^2, $p<.01$).

DISCUSSION OF EXPERIMENTAL RESULTS

With reasonable extrapolation the results of this laboratory experiment can be related to the sorts of problems likely to be encountered in designing practical training programs. Perhaps the first notable trend is that there were no significant differences between the methods (overall main effects) in terms of total instructional time required (including any demonstrations). All the training conditions insured that the great bulk of the student's time was spent on relevant activities; for instance, the Army film was severely edited, and only the actual demonstrations of the relevant task were retained. The assistance of the experimenter would insure that no great time periods were lost as a result of confusion. The data for assists, however, show many sharp differences, and the level of assistance given under many treatment categories is clearly excessive in relation to the general availability of instructors.

The very low number of assists when the revised film is viewed step by step demonstrates how reliably one can communicate this kind of skill by a demonstration film. In classroom practice, one might show a film step by step by allowing everyone to finish each step before proceeding with the next step. By having a few seconds of black leader between steps, this technique can be used conveniently with conventional projectors. Probably one would want a second showing step by step to reduce need for assistance, but allowing the more able soldiers to anticipate (work somewhat ahead of) the demonstration, thus making it a self-test for them. If only an occasional assist were needed, it could perhaps be supplied by another student who understood the demonstration. The difficulty of the particular task would determine both the number of trials needed and various other details of the training procedure, matters which should therefore be worked out by trying each program with students.

There is a price to be paid for using step-by-step viewing and for developing a film empirically, such as our revised version. The step-by-step presentation appears to start everyone at a fairly elementary level of learning; this is perhaps the best explanation of the fact that the step-by-step viewers did not seem to benefit from an extra viewing of the film before the step-by-step viewing (either in practice time scores or assist scores), since what they learned during the first viewing would duplicate the elementary sort of learning in the subsequent step-by-step viewing. This explanation is also consistent with the findings of Gropper (33), who noted that the optimum length of demonstration unit tends to be longer for higher IQ students, and of Margolius and Sheffield (4), who found that the more capable learners were those who tended to choose longer demonstration units.

By the nature of the step-by-step treatment, such guidance does not allow a student to demonstrate his competence on that practice trial. (Even on the rather complex task in this experiment, when the revised film was viewed twice continuously, 7 out of the 12 subjects could perform the task without an assist on the very first trial.) On the other hand, step-by-step demonstration does apparently allow low ability subjects to learn tasks which by other training methods would be impossible (60). And in the perspective of general training practice, one generally is most concerned with rapid, businesslike progress for all students, rather than with the ultimate in efficiency.

In some situations the step-by-step method may be considered needlessly clumsy. By use of a carefully revised film, developed by a process like the one described above, one may still train with a rather small amount of assistance. When viewed continuously, an extra viewing of the film seems to save about as much practice time as it takes to show the film, at the same time sharply reducing the need for assists, though the extra viewing appeared to be a waste of time for the step-by-step viewers. The step-by-step method seems to be very useful in film development, even if the final film is shown without interruption.

Considerable time and effort were required to develop the revised film. Although such cost would be considered negligible for courses developed for a large number of students, in courses with few students the cost could not always be justified.

The effort of developing a film could perhaps be reduced by applying the principles presented in the following section and in the literature. Somewhat abbreviated development might be appropriate for some courses, because one reaches the point of diminishing returns in later revisions, but if the demonstration film is worth producing at all, it would seem worthwhile to *always* conduct some tryouts and revisions.

The pictorial book program produced mastery in amounts of time generally comparable to those for the film conditions, and the number of assists was roughly comparable to that for the Army film conditions. Apparently, the disadvantage of the book in not presenting moving stimuli or coordinated audio directions is compensated for by its natural advantage of flexibility in use: (a) The subject is not forced to view a presentation for a fixed period whether he needs it or not; (b) he can review at will the points he is unsure of; (c) often he can take a book program to the job in situations where a movie would be awkward or impossible.

Although the revised film generally required fewer assists than the picture-guide book, especially under the step-by-step or the two-viewings treatment, the film was subject to a much more extensive development than the book, which was produced under a stricter production schedule. The pictorial programed books seem likely to become increasingly important as their techniques become further developed and for situations in which their unique advantages of flexibility are at a premium.

RESULTS AND DISCUSSION OF PRINCIPLES UNDERLYING THE FILM DEVELOPMENT

In revising the Army film for better communication (to reduce error, hesitation, and fumbling) the changes made and the rationale for making them were explicitly recorded. Since each change transformed an apparently ineffective segment of the film into an apparently effective one, the reasons for making the changes may in a sense be considered results of informal experimentation. Although such instances may have little statistical status as evidence, they gain strength as they occur repeatedly and are interrelated in a systematic rationale.

Two distinct advantages of this kind of evidence are its efficiency in terms of research effort, and its sensitivity in terms of detecting nuances of visual communication. The relation between communication and action is most direct.

The process of validating films empirically is very sensitive to omissions or misleading presentation, but very insensitive to redundancy and superfluous detail. Hence, it is important to follow two general rules in preparing a draft version: (a) Be as brief as possible, searching for ways to condense and simplify, and (b) when in doubt, choose the most succinct treatment being considered, relying on subsequent tryouts to reveal omissions. Programers are *always* surprised, at first, to find which sections the students find easy, and which sections they find difficult.

Although the revised film is a distinct improvement in general terms, the assist data on any specific item seldom support adequate statistical tests. One would have to have at least six instances of the need for assists to provide even a possibility of statistical significance at the .05 level. In the data for step-by-step viewing, there are two such items where significance is possible, and both—significantly—favor the revised film (a ten-zero split on remembering to lift the feed tray, and a six-zero split on replacing the feed tray with the bullet ramp forward).

A list of the principles organized in coherent form follows. Each principle was developed from reasons underlying actual changes made, and most of the rules were developed from several instances.

Principles for Movie Development

I. Content photographed
   A. Actor's performance
      1. The performance (including motion, grip, stance) should *approximate normal performance* of the task, and should avoid grossly artificial postures, awkward reaching, extra manipulations which the student is *not* expected to imitate (especially if these involve dangerous or otherwise undesirable actions), and minimize the actor's pointing to critical cues. (It is preferable generally to use another technique for cue emphasis, such as animation.) The Army film, in presenting a point on safety, demonstrated what the man was *not* supposed to do, so that a trainee copying the demonstration might get himself into a dangerous situation.
      2. The component movements, especially the critical ones, should be slow, clear, and distinct; the less critical (routine) motions should be easier, and a little faster.
      3. Normal performance may be modified somewhat to intensify suggestion of desired action (dramatic quality based on population stereotypes). For example, in pushing a button, a straight finger pointing in the desired direction of motion will suggest pushing.
      4. Normal performance may be modified somewhat to avoid obscuring critical cues or motions. (See also B.)
      5. Normal performance may be modified somewhat to indicate extra actions are *not* taking place. In illustration of this principle and the preceding one, the actor in the revised film pressed the trigger (which on the M-73 is a strange flap on the back) with his thumb and held the rest of his hand open and well clear of the weapon, instead of using his palm, which in the Army version covered a large area of the back of the weapon.

B. Camera viewpoint
   1. Maintain essentially a subjective (or over-the-shoulder) point of view.
   2. Make no abrupt changes in viewpoint.
   3. To get at critical cues which cannot be seen from normal position:
      a. On large, stationary objects, pan around object, simulating the person's head movements.
      b. On smaller, movable objects, turn the object (but slowly, so that viewer does not lose orientation).

II. Emphasis on critical cues from the environment
   A. Animation
      1. You may emphasize (or exaggerate) intrinsic visual cues (e.g., you may draw attention to critical features on machinery by rubbing chalk on some edges to exaggerate the highlights).
      2. You may use animation devices (clearly extrinsic to task cues) to draw attention to critical parts, or to indicate the desired action (e.g., a circle around a part to be manipulated, or an arrow indicating the direction a part is to be moved).
   B. Sound cues
      1. You may need to restore certain critical sound cues, and synchronize them with the action. (It is common practice to use the audio for narrative, which may result in losing important task cues. Such cues generally serve as terminal cues, indicating when an action has been completed satisfactorily. Three such instances arose in revising the Army film.)
   C. Photographic technique
      1. Clarity may be enhanced by close-ups, lighting, resolution, focus.
      2. Composition may serve to direct attention through centering critical aspects, framing (cropping or close-ups), or eliminating distracting clutter from the background.
      3. Time usage may serve to emphasize importance of cues and actions. (Often only a tryout with novices will indicate which features *are* really critical to task performance, and which other cues would be discovered readily as the student carries out the indicated actions.)

III. Language problems
   A. Timing of narrative. The narrative should lead, by a short interval, the action it directs, as if the actor were following the commands on the audio.
   B. Reference to objects. Ambiguous term-to-object correspondence may be clarified by the following techniques:
      1. Using one of the above-listed techniques, such as timing or animation arrows, to clarify the correspondence.
      2. Simplify and/or explain the terms used; use only relevant technical terms, and take time to explain as necessary. (For instance, in seating the feed tray, the Army narrative said, "Make sure the bullet ramp is to the front." The revised film added, "The bullet ramp is the wide part of the slot, where the bullets drop through into the barrel," and the slot was backed by white paper to attract attention and emphasize its shape.)
      3. Reference to action. Ambiguous term-to-action correspondence (whether the action is a manipulation or the underlying mechanical dynamics) may be clarified by explanation (which should rely on known terms, associations, and population stereotypes).

IV. Organization. The order of some steps, and the division of the action into natural units for trial, may be designed to capitalize on common associations of ideas.

LITERATURE CITED
AND
APPENDICES

LITERATURE CITED

1. Kimble, G.A., and Wulff, J.J. "'Response Guidance' as a Factor in the Value of Student Participation in Film Instruction," Chapter 15 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

2. Klass, Philip J. "Video-Sonics' Cuts Production Defects," *Aviation Week*, January 4, 1960, vol. 72, pp. 75-81.

3. Maccoby, N., and Sheffield, F.D. "Combining Practice With Demonstration in Teaching Complex Response Sequences. Summary and Interpretation," Chapter 5 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

4. Margolius, G.J., and Sheffield, F.D. "Optimum Methods of Combining Practice With Filmed Demonstration in Teaching Complex Response Sequences: Serial Learning of a Mechanical-Assembly Task," Chapter 3 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

5. Margolius, G., Sheffield, F.D., and Maccoby, N. "Repetitive Versus Consecutive Demonstration and Practice in the Learning of a Serial Mechanical-Assembly Task," Chapter 6 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

6. Miller, E.E. *Transfer Effects of Special Training Upon Pre-solo Flight Training*, Research Report NM 16 01 11, Subtask 13, No. 1, U.S. Naval School of Aviation Medicine, Naval Air Station, Pensacola, September 1958.

7. Pan, S. "The Influence of Context Upon Learning and Recall," *Journal Experimental Psychology*, vol. 9, 1926, pp. 468-491.

8. Sheffield, F.D. "Theoretical Considerations in the Learning of Complex Sequential Tasks From Demonstration and Practice," Chapter 2 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

9. Gropper, G.L. *Controlling Student Responses During Visual Presentations, Report No. 2. Studies in Televised Instruction: The Role of Visuals in Verbal Learning. Study No. 1—An Investigation of Response Control During Visual Presentations. Study No. 2—Integrating Visual and Verbal Presentations*, American Institutes for Research, Pittsburgh, October 1965.

10. Gropper, G.L. "Learning From Visuals: Some Behavioral Considerations," *Audio-Visual Communication Review*, vol. 14, Spring 1966, pp. 37-69.

11. Cheatham, T.P. "Audio-Visual Techniques of Programed Instruction—A Broader View," in *Revolution in Training: Programed Instruction in Industry*, T.B. Dolmath, B. Marting, and R.G. Finley (eds.), American Management Association, New York, 1962, pp. 124-130.

12. Hickey, A.E. "Programed Instruction in Business and Industry," in *Applied Program Instruction*, S. Margulies and L.D. Eigen (eds.), John Wiley and Sons, Inc., New York, 1962, pp. 282-294.

13. Mager, R.F. *Preparing Objectives for Programmed Instruction*, Fearon Publishers, San Francisco, March 1962.

14. Smith, Robert G. *The Development of Training Objectives*, HumRRO Research Bulletin 11, June 1964,

15. Ammerman, Harry L., and Melching, William H. *The Derivation, Analysis, and Classification of Instructional Objectives*, HumRRO Technical Report 66-4, May 1966.

16. Shettel, H.H., and Lindley, R.H. *An Experimental Comparison of Two Types of Self-Instructional Programs for a SAGE System Paired-Associate Task*, AFCCDD-TN-61-20, American Institutes for Research, Pittsburgh, March 1961.

17. Cox, John A., Wood, Robert O., Jr., Boren, Lynn M., and Thorne, H. Walter. *Functional and Appearance Fidelity of Training Devices for Fixed-Procedures Tasks*, HumRRO Technical Report 65-4, June 1965.

18. Dougherty, Dora J., Houston, R.C., and Nicklas, D.R. *Transfer of Training in Flight Procedures from Selected Ground Training Devices to the Aircraft*, TR 71-16-16, U.S. Naval Training Device Center, Port Washington, New York, September 1957.

19. Grimsley, Douglas L. *Acquisition, Retention, and Retraining: Effects of High and Low Fidelity in Training Devices*, HumRRO Technical Report 69-1, February 1969.

20. Weiss, W., Maccoby, N., and Sheffield, F.D. "Combining Practice With Demonstration in Teaching Complex Sequences: Serial Learning of a Geometric-Construction Task," Chapter 4 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

21. Cook, J.O. "Supplementary Report: Processes Underlying Learning a Single Paired-Associate Item," *Journal Experimental Psychology*, 1958, vol. 56, no. 5, 455.

22. Cook, J.O., and Kendler, T.S. "A Theoretical Model to Explain Some Paired-Associate Learning Data," in *Symposium on Air Force Human Engineering, Personnel, and Training Research*, G. Finch and F. Cameron (eds.), National Academy of Sciences--National Research Council, Washington, 1956.

23. Irion, A.L., and Briggs, L.J. *Learning Task and Mode of Operation Variables in Use of the Subject-Matter Trainer*, Technical Report AFPTRC-TR-57-8, Air Force Personnel and Training Research Center, Lackland Air Force Base, October 1957.

24. Lau, A.W. *A Comparison of Prompting Versus Feedback in Verbal and Perceptual Learning*, Technical Bulletin STB 67-8, U.S. Naval Personnel Research Activity, San Diego, October 1966.

25. Kopstein, F.F., and Roshal, S.M. "Verbal Learning Efficiency as Influenced by the Manipulation of Representational Response Processes," Chapter 20 in *Student Response in Programmed Instructions: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

26. Cook, J.O., and Spitzer, M.E. "Supplementary Report: Prompting Versus Confirmation in Paired-Associate Learning," *Journal of Experimental Psychology*, vol. 59, no. 4, 1960, pp. 275-276.

27. Angell, D., and Lumsdaine, A.A. *Prompted Plus Unprompted Trials Versus Prompted Trials Alone in Paired-Associate Learning*, American Institutes for Research, Pittsburgh, 1960.

28. Annett, J., and Paterson, L. *The Use of Cuing in Training Tasks: Phase III*, NAVTRADEVCEN 4717-1, U.S. Naval Training Device Center, Orlando, August 1967.

29. Annett, J., and Clarkson, J.K. *The Use of Cuing in Training Tasks*, NAVTRADEVCEN 3143-1, U.S. Naval Training Device Center, Orlando, April 1964.

30. Annett, J., and Paterson, L. *The Use of Cuing in Training Tasks: Phase II*, Technical Report 4119-1, U.S. Naval Training Device Center, Orlando, 1966.

31. Pressey, S.L. "Teaching Machine and Learning Theory Crisis," *Journal Applied Psychology*, vol. 47, no. 1, 1963, pp. 1-6.

32. Maccoby, N., and Sheffield, F.D. "Theory and Experimental Research on the Teaching of Complex Sequential Procedures by Alternate Demonstration and Practice," in *Symposium on Air Force Human Engineering, Personnel, and Training Research* (Publication 516), G. Finch and F. Cameron (eds.), National Academy of Sciences—National Research Council, Washington, 1958.

33. Gropper, G.L. "Programing Visual Presentations for Procedural Learning," *Audio-Visual Communication Review*, vol. 16, no. 1, Spring 1968, pp. 33-56.

34. Jaspen, N. *Effects on Training of Experimental Film Variables: Study II: Verbalization, "How-it-Works," Nomenclature, Audience Participation, and Succinct Treatment*, Technical Report No. SDC 269-7-11, U.S. Naval Training Device Center, Port Washington, New York, March 1950. (Instructional Film Research Program, Pennsylvania State University)

35. McGuire, W.J. "Some Factors Influencing the Effectiveness of Demonstrational Films," Chapter 13 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

36. Levine, S. "The Role of Motivation in the Effects of 'Active Review' on Learning From a Factual Film," *American Psychologist*, vol. 8, 1953, pp. 388-389 (Abstract).

37. Lumsdaine, A.A., May, M.A., and Hadsell, R.S. "Questions Spliced Into a Film for Motivation and Pupil Participation," in *Learning From Films*, M.A. May and A.A. Lumsdaine, (eds.), Yale University Press, New Haven, 1958, pp. 72-83.

38. Maccoby, N., Michael, D.N., and Levine, S. "Further Studies of Student Participation Procedures in Film Instruction," Chapter 13 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

39. Michael, D.N., and Maccoby, N. "Factors Influencing the Effects of Student Participation on Verbal Learning From Films," Chapter 18 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

40. Michael, D.N., and Maccoby, N. "Factors Influencing Verbal Learning From Films Under Varying Conditions of Audience Participation," *Journal of Experimental Psychology*, vol. 46, 1953, pp. 411-418.

41. Lumsdaine, A.A., and Sulzer, R.L. *The Influence of Simple Animation Techniques on the Value of a Training Film*, HRRL Report No. 24, U.S. Air Force Human Factors Research Laboratories, Washington, 1951.

42. Lumsdaine, A.A., and Gladstone, A. "Overt Practice and Audio-Visual Embellishments," in *Learning from Films*, M.A. May and A.A. Lumsdaine (eds.), Yale University Press, New Haven, 1958, pp. 58-71.

43. May, M.A. "The Psychology of Learning from Demonstration Films," *Journal of Educational Psychology*, vol. 37, 1946, pp. 1-12.

44. May, M.A. "Verbal Responses to Demonstrational Films," in *Learning from Films*, M.A. May and A.A. Lumsdaine, (eds.), Yale University Press, New Haven, 1958.

45. Wulff, J.J. *The Teaching Effectiveness of a Filmed Mechanical Assembly Demonstration With Supplementary Nomenclature Training*, TARL-LN-55-8, AFPTRC Training Aids Research Laboratory, 1955. (Unpublished laboratory note cited by Lumsdaine, 8)

46. Roshal, S.M. *Effects of Learner Representation in Film-Mediated Perceptual-Motor Learning*, Technical Report No. SDC 269-7-5, U.S. Naval Training Device Center, Office of Naval Research, Port Washington, New York, 1949. (Instructional Film Research Program, Pennsylvania State University)

47. Sheffield, F.D., and Maccoby, N. "Summary and Interpretation of Research on Organizational Principles in Constructing Filmed Demonstrations, Chapter 9 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

48. Sheffield, F.D., Margolius, G.J., and Hoehn, A.J. "Experiments on Perceptual Mediation in the Learning of Organizable Sequences," Chapter 8 in *Student Response in Programmed Instruction: A Symposium*, A.A. Lumsdaine (ed.), National Academy of Sciences—National Research Council, Washington, 1961.

49. McTavish, C.L. *Effect of Repetitive Film Showings on Learning*, Technical Report No. SDC 269-7-12, U.S. Naval Training Device Center, Port Washington, New York, November 1949.

50. Kurtz, A.K., Walter, J.S., and Brenner, H.R. *The Effects of Inserted Questions and Statements on Film Learning (Rapid Mass Learning)*, Technical Report No. SDC 269-7-16, U.S. Naval Training Device Center, Port Washington, New York, September 1950. (Instructional Film Research Program, Pennsylvania State University)

51. Sulzer, R.L., Lumsdaine, A.A., and Kopstein, F.F. *The Value of Using Multiple Examples in Training Film Instruction*, HRRL Report No. 25, U.S. Air Force Human Resources Research Laboratories, Washington, May 1962.

52. Rimland, B. *Effectiveness of Several Methods of Repetition of Films*, Technical Report No. SDC 269-7-45, U.S. Naval Special Device Center, Port Washington, New York, May 1955. (Instructional Film Research Program, Pennsylvania State University)

53. Gropper, G.L., Lumsdaine, A.A., and Shipman, V. *Improvement of Televised Instruction Based on Student Responses to Achievement Tests, Report No. 1. Studies in Televised Instruction: The Use of Student Response to Improve Televised Instruction*, American Institutes for Research, Pittsburgh, March 1961.

54. Gropper, G.L., and Lumsdaine, A.A. *Requiring Active Student Response, Report No. 2. Studies in Televised Instruction: The Use of Student Response to Improve Televised Instruction*, American Institutes for Research, Pittsburgh, March 1961.

55. Gropper, G.L., and Lumsdaine, A.A. *Issues in Programming Instructional Materials for Televised Presentation, Report No. 5. Studies in Televised Instruction: The Use of Student Response to Improve Televised Instruction*, American Institutes for Research, Pittsburgh, March 1961.

56. Gropper, G.L., and Lumsdaine, A.A. *An Overview, Report No. 7. Studies in Televised Instruction: The Use of Student Response to Improve Televised Instruction,* American Institutes for Research, Pittsburgh, March 1961.

57. Cronbach, L.J., and Meehl, P.E. "Construct Validity in Psychological Tests," *Psychological Bulletin,* vol. 52, no. 4, July 1955, pp. 281-302.

58. Winer, B.J. *Statistical Principles in Experimental Design,* McGraw-Hill Book Company, Inc., New York, 1962.

59. Siegel, S. *Nonparametric Statistics for the Behavioral Sciences,* McGraw-Hill Book Company, Inc., New York, 1956.

60. Taylor, John E., and Fox, Wayne L. *Differential Approaches to Training,* HumRRO Professional Paper 47-67, September 1967.

Appendix A

RECORDING FORM (ARMY FILM)

Subject: #_______________ Name:____________________ cell____________________

batch____________________ S.N.:____

Trials	1 needed assist	1 time	2 needed assist	3 needed assist	after needed assist
DISASSEMBLY					
I. Checking weapon 1. *cover latch—lift cover feed tray up					
2. *charging handle—not cocked —forgot					
3. *on "safe"					
•check					
•on "fire"					
4. *release (fire)					
•close cover					
II. Cover group 5. *cover off					
6. *feed tray off					
III. Backplate Group 7. *guide rods and springs					
8. *backplate					
IV. Barrel and Bar. ext. hands not clear (safety)					
9. *charger handle—forgot					
—not cocked					
10. *buffer support lever					
•back and out					
•support barrel					
11. *breech block—forgot					
—couldn't do it					
V. Charger assembly 12. *ring					
•charger off					
VI. Barrel jacket 13. *pull back disconnector, rotate B. * B. J.					
•forward and off					
Sequence of lay down					

Appendix B

INSTRUCTIONS

Good-morning (afternoon), I'm Specialist Pepper, Research Psychological Assistant. Welcome to the Human Research Unit. We're an Army Organization working with a group of civilian research scientists through The George Washington University, Washington, D.C.

Directions I: Film Without Interspersed Practice

You'll be working with the M-73 machine gun, learning to disassemble and assemble it. We have a special movie which shows you how to do it. Pay attention, because after you see the movie, you'll try to do the same thing yourself with the weapon in front of you. You may ask for help from Specialist Pepper whenever you can't understand or remember what to do next. Try to remember what you do, because you will repeat practice until you can go through the whole operation without help.

After First Showing of Film (Before "Subject" Begins Disassembly)

Be sure you check and clear the weapon before you begin the disassembly.

After Subject's First Performance

Now, we'll show the film again, and you'll try the operation again. You'll be through as soon as you can disassemble and assemble the weapon without help.

Directions II: Film With Interspersed Practice

You'll be working with the M-73 machine gun, learning to disassemble and assemble it. We have a special movie which shows you how to do it.

The movie will guide you through the disassembly and assembly operations. The movie will demonstrate the first step, then stop—and allow you to do that much. When you have finished the first step, push the green button and the movie will show you the second step, then stop while you perform that step, and so on, until you complete the disassembly and assembly of the weapon. You may ask for help from Specialist Pepper whenever you can't understand or remember what to do next.

Try to remember what you do because you will repeat practice until you can go through the whole operation without any mistakes.

After Showing of Film and Before Disassembly

Now you will begin the actual disassembly of the weapon, without the film. Be sure you check and clear the weapon before you begin.

Directions III: Book With Interspersed Practice

You'll be working with the M-73 machine gun, learning to disassemble and assemble it. In front of you, there's a special book which shows you how to do it. The book will guide you through the disassembly and assembly operations. The first page will illustrate the first step, and you will do that much. When you have finished the first step, turn the page and the next page will show you the second step as you do it, and so on, until you complete the disassembly and assembly of the weapon. You may ask for help from Specialist Pepper whenever you can't understand or remember what to do next.

Try to remember what you do, because you will repeat practice until you can go through the whole operation without depending on the book.

Before Second Time

Now, you'll use the book the same way, except that you may remember some of the steps before you see them pictured. So when you can, do the step first, then turn the page to check yourself with the book. You may see the step first if you wish. You will be through as soon as you can perform the operations without depending on the book—that is, as soon as you can perform each step, only using the book afterward, to check yourself.

Appendix C

DISTRIBUTIONS OF ERRORS

Table C-1

Distributions of Errors or Assists on First Trial

Assists	Army Film								Revised Film								Book
	Step-by-Step Viewing				Continuous Viewing				Step-by-Step Viewing				Continuous Viewing				
	once		twice		once		twice		once		twice		once		twice		
	AI[a]	II	AI	II	AI	II	AI	II	AI	II	AI	II	AI	II	AI	II	
0	3	1	1	0	1		2	2	4	5	6	5	2		5	2	6
1	1	1	1	1				1	2	1		1			1	1	11
2	1	1	4	4			1						1	1		2	16
3	1	3		1	1	1	2						1	2			4
4						1		1								1	8
5					2	1		1					1				1
6						1	1										1
7					2	2		1									
8													1	1			1
9																	
10														1			
11														1			

[a]AI = Army Introduction
II = Implosion Introduction

Table C-2

Distributions of Errors or Assists After First Trial

Assists	Army Film								Revised Film								Book
	Step-by-Step Viewing				Continuous Viewing				Step-by-Step Viewing				Continuous Viewing				
	once		twice		once		twice		once		twice		once		twice		
	AI[a]	II	AI	II	AI	II	AI	II	AI	II	AI	II	AI	II	AI	II	
0	4	4	4	1	4	6	6	5	3	4	4	5	6	5	6	6	24
1		1						1									4
2			2	2	2				2	1				1			8
3	1	1		3					1		1						5
4	1										1						4
5										1		1					2
6																	1
7																	

[a]AI = Army Introduction
II = Implosion Introduction

Appendix D

DISTRIBUTIONS OF TRIALS

Table D-1

Distributions of Trials to Criterion by Treatment

Assists	Army Film								Revised Film								Book
	Step-by-Step Viewing				Continuous Viewing				Step-by-Step Viewing				Continuous Viewing				
	once		twice		once		twice		once		twice		once		twice		
	AI[a]	II	AI	II	AI	II	AI	II	AI	II	AI	II	AI	II	AI	II	
0																	
1					1		2	1					1		2	1	
2	5	4	4	1	3	6	4	4	2	4	4	5	5	5	4	5	23
3	1	2	2	5	2			1	4	2	2	1		1			23
4																	2

[a] AI = Army Introduction
II = Implosion Introduction

Distribution List

2 DIR OASD MANPOWER (PP&GR)
1 CHF DASA ATTN DOC LIB B?
1 DIR WSEG WASH., D.C. 20305
1 DIR OASD MANPOWER & RESERVE AFFAIRS
1 OFC OF THE ASST SEC OF DEF (M&RA) ATTN SPEC ASST POLICY STUDIES
2 COMDR FLD COMD DEF ATOMIC SPT AGY SANDIA BASE ATTN FCTG7
2 NASA SCI & TECH INFO FACILITY COLLEGE PARK MD
1 CINC US EUROPEAN COMD ATTN SUPPORT PLANS BR J3
1 CINC USA PACIFIC ATTN G3 CDC APO SAN FRAN 96610
1 CG US ARMY JAPAN APO 96343 SAN FRAN ATTN G3
10 CG USA FORCES SOUTHERN COMD ATTN SCARCO CZ
2 CG US ARMY EUROPE APO 09403 NY ATTN OPNS DIV
1 CO ARMY TRANS RES COMD FT EUSTIS ATTN TECH LIB
1 CG USA AD COMD ENT AFB ATTN ADGPA COLO
6 CG 1ST ARMY ATTN DCSOT FT MEADE MD
1 CG 3RD ARMY ATTN DCSOT FT MCPHERSON
2 CG 4TH ARMY ATTN AKADC=R(UT) FT SAM HOUSTON
8 CG 4TH ARMY ATTN DPTSEC AKPSH-OPS-T FT HOUSTON
2 CG SIXTH ARMY PRES OF SAN FRAN ATTN AMOPS-T2
1 CG EUSA ATTN AG-AC APO 96301 SAN FRAN
1 DIR HEL APG MD
1 CG USA CDC EXPERIMENTATION COMD FT ORD
2 ENGNR PSYCHOL LAB PIONEERING RES DIV ARMY NATICK LABS NATICK MASS
1 TECH LIB ARMY NATICK LABS NATICK MASS
2 INST OF LAND CBT ATTN TECH LIB FT BELVOIR VA
1 REDSTONE SCIENTIFIC INFO CTR US ARMY MSL COMD ATTN CHF DOC SEC ALA
1 CO FT HUACHUCA SPT COMD USA ATTN TECH REF LIB
1 SIXTH USA LIB DEPOT BLDG M 13 14 PRES OF SAN FRAN
1 PLNS OFCR PSYCH HOQTRES USACDCEC FT ORD
5 CG FT ORD ATTN G3 TNG DIV
1 DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
2 DIR WRAIR WALTER REED ARMY MED CTR ATTN NEUROPSYCHIAT DIV
1 CO HQ ARMY ENLISTED EVAL CTR FT BENJ HARRISON
1 TECH LIB BOX 22 USACDC EXPERIMENTATION COMD FT ORD
1 HUMAN FACTORS TEST DIV (AGHZ) USAF HOSP EGLIN AFB
1 CO FRANKFORD ARSNL ATTN SMUFA-N6400/202-4 PA
3 6TH RGN USARADCOM FT BAKER
1 4TH ARMY MSL COMD AIR TRANSPORTABLE SAN FRAN
1 DIR ARMY BD FOR AVN ACCIDENT RSCH FTRUCKER
2 CO PICATINNY ARSNL DOVER N J ATTN SUMPA VCI
1 LIB DEF SUPPLY AGCY CAMERON STA VA
2 CO USA CDC AG AGCY FT BENJ HARRISON IND
1 REF M MS IS NASA ALA
1 CO USA CBT DEVEL COMD TRANS AGCY FT EUSTIS
1 CO ARMY CDC INF AGY FT BENNING
1 CO ARMY CDC ARMOR AGY FT KNOX
1 CO US ARMY CDC AVN AGCY FT RUCKER
3 CO USA TNG CTR (FA) ATTN AKPSITC-TT FT SILL
1 CG USA TNG CTR & FT LEONARD WOOD ATTN ACOFS G3
1 CG USA INF CTR ATTN AJICT-T FT BENNING
1 CG USA TNG CTR INF ATTN ACOFS G3 FT DIX
1 CG USA TNG CTR ATTN ACOFS G3 FT JACKSON
1 CG USA TNG CTR INF ATTN ACOFS G3 FT LEWIS
1 CG USA TNG CTR INF & FT ORD ATTN ACOFS G3
39 CG USA TNG CTR INF ATTN ACOFS G3 FT POLK
5 CO USA MED TNG CTR ATTN DIR OF TNG FT SAM HOUSTON
20 CG USA AD CTR ATTN G3 FT BLISS
1 CG USA TNG CTR INF ATTN ACOFS G3 FT CAMPBELL
3 LIB ARMY WAR COLL CARLISLE BKS
1 COMDT COMD + GEN STAFF CO FT LEAVENWORTH ATTN ARCHIVES
1 DIR OF MILIT PSYCHOL + LDRSHP US MILIT ACAD WEST POINT
1 US MILIT ACAD WEST POINT ATTN LIB
1 COMDT ARMY AVN SCH ATTN DIR OF INSTR FT RUCKER
2 COMDT ARMY SECUR AGY TNG CTR + SCH FT DEVENS ATTN LIB
1 STIMSON LIB MED FLD SERV SCH BROOKE ARMY MED CTR FT SAM HOUSTON
3 COMDT THE ARMOR SCH ATTN DOI FT KNOX
1 COMDT ARMY ARMOR SCH FT KNOX ATTN WEAPONS DEPT
1 COMDT USA CHAPLAIN SCH ATTN DOI FT HAMILTON
1 COMDT ARMY CHEM CORPS SCH FT MCCLELLAN ATTN EDUC ADV
1 COMDT USA FIN SCH ATTN CHF DOC DEV LIT PLN DIV ODOI IND
1 USA FINANCE SCH FT BENJ HARRISON ATTN EDUC ADV
4 COMDT ADJ GEN SCH FT BENJ HARRISON ATTN EDUC ADV
1 COMDT USAIS ATTN EDUC ADV FT BENNING
1 COMDT USAIS ATTN AJIIS=D=EPRD FT BENNING
1 HQ US ARMY ADJ GEN SCH FT BENJ HARRISON ATT COMDT
1 LIB ARMY QM SCH FT LEE
1 COMDT USA QM SCH FT LEE ATTN EDUC ADV
1 COMDT ARMY TRANS SCH FT EUSTIS ATTN EDUC ADV
1 CO USA SEC AGY TNG CTR & SCH ATTN IATEV RSCH ADV FT DEVENS
1 COMDT USA MIL POLICE SCH ATTN PLNS &PROG ODOI FT GORDON
2 COMDT US ARMY SOUTHEASTERN SIG SCH ATTN EDUC ADV FT GORDON
1 COMDT USA AD SCH ATTN DOI FT BLISS
1 CO USA ORD CTR & SCH OFC OF OPS ATTN AHBN-O APG MD
5 ASST COMDT ARMY AIR DEF SCH FT BLISS ATTN CLASSF TECH LIB
3 CG USA FLD ARTY CTR & FT SILL ATTN AVN OFCR
1 COMDT DEF INTELL SCH ATTN SIGAS DEPT
1 COMDT ARMED FORCES STAFF COLL NORFOLK
1 COMDT USA SIG CTR & SCH ATTN DOI FT MONMOUTH
1 COMDT JUDGE ADVOCATE GENERALS SCH U OF VA
1 DPTY COMDT USA AVN SCH ELEMENT GA
1 DPTY ASST COMDT USA AVN SCH ELEMENT GA
1 USA AVN SCH ELEMENT OFC OF DIR OF INSTR ATTN EDUC ADV GA
1 EDUC CONSLT ARMY MILIT POLICE SCH FT GORDON
6 COMDT USA ENGR SCH ATTN EDUC ADV AHBBES-EA FT BELVOIR
2 COMDT USA SCH EUROPE ATTN EDUC ADV APO 09172 NY
1 OFC OF DOCTRINE DEV LIT & PLNS USA ARMOR SCH ATTN AHBAAS-DM
1 COMDT ARMY AVN SCH FT RUCKER ATTN EDUC ADV
1 DIR OF INSTR US MIL ACAD WEST POINT NY
1 DIR OF MILIT INSTR US MILIT ACAD WEST POINT
1 USA INST FOR MIL ASSIST ATTN LIB BLDG 1ST28G8 FT BRAGG
4 USA INST FOR MIL ASSIST ATTN COUNTERINSURGENCY DEPT FT BRAGG
1 COMDT DEF MGT SCH FT BELVOIR
2 COMDT USA MSL & MUN CTR & SCH ATTN CHF OFC OF OPS REDSTONE ARSNL
2 COMDT US WAC SCH US WAC CTR ATTN AJMCT FT MCCLELLAN
2 HQ ABERDEEN PG ATTN TECH LIB
1 COMDT USA INTELL SCH ATTN DIR OF ACADEMIC OPS FT HOLABIRD
1 COMDT USA INTELL SCH ATTN DIR OF DOC & LIT FT HOLABIRD
1 COMDT USA C&GSC OFC OF CHF OF RESIDENT INSTR FT LEAVENWORTH
1 COMDT USA CA SCH ATTN OFC OF DOCTRINE DEVEL LIT & PINS FT GORDON
1 COMDT USA CA SCH ATTN DOI FT GORDON
1 COMDT USA CA SCH ATTN EDUC ADV FT GORDON
1 COMDT USA CA SCH ATTN LIB FT GORDON
1 COMDT USA SCH & TNG CTR ATTN ACOFS G3 TNG DIV FT MCCLELLAN
1 COMDT USA SCH & TNG CTR ATTN ACOFS G3 PLNS & OPS DIV FT MCCLELLAN
10 COMDT USA INST FOR MIL ASSIST ATTN DOI FT BRAGG
9 COMDT USA FLD ARTY SCH ATTN DOI FT SILL
1 COMDT USA ARTY SCH ATTN EDUC SERVICES DIV FT SILL
1 COMDT USA ARTY SCH ATTN EDUC ADV FT SILL
1 COMDT USA TRANS SCH ATTN DIR OF DOC & LIT FT EUSTIS
1 COMDT USA TRANS SCH ATTN LIB FT EUSTIS
1 USA INST FOR MIL ASST ATTN EDUC ADV FT BRAGG
1 COMDT USA C&GSC ATTN ATSCS-DJ (SPWAR)
1 COMDT ARMY QM SCH OFC DIR OF NONRESID ACTVY ATTN TNG MEDIA DIV VA
1 COMDT USA ARTY SCH ATTN LIB FT SILL
1 CG USA SCH & TNG CTR ATTN ACOFS G3 FT GORDON
1 DIR OF GRAD STUD & RSCH ATTN BEHAV SCI REP USAC&GSC
1 COMDT USA AD SCH ATTN AKBAAS-DL=EA FT BLISS
1 COMDT USA AD SCH HIGH ALTITUDE MSL DEPT FT BLISS
2 DIR BRGD + BN OPNS DEPT USAIS FT BENNING
1 DIR COMM ELEC USAIS FT BENNING
1 DIR ABN=AIR MOBILITY DEPT USAIS FT BENNING
1 CG USA SIG CTR & SCH ATTN ATSSC=DP-COB FT MONMOUTH
1 CG USA SIG CTR & SCH ATTN ATSSC-EA FT MONMOUTH
1 SECY OF . "Y, PENTAGON
1 DCS=PERS DA ATTN CHF C+S DIV
1 DIR OF PERS STUDIES & RSCH ODCSPER DA WASH DC
2 ACSFOR DA ATTN CHF TNG DIV WASH DC
1 CG USA MAT COMD ATTN AMCRD=TE
1 CHF OF ENGNRS DA ATTN ENGTE-T
1 HQ ARMY MAT COMD R+D DRCTE ATTN AMCRD-RC
1 US ARMY BEHAVIOR & SYS RSCH LAB ATTNCRD=AR ARL VA
1 OPO PERS MGT DEV OFC ATTN MOS SEC (NEW EQUIP) OPOMD
1 PROVOST MARSHAL GEN DA
1 DIR CIVIL AFFAIRS DRCTE ODCSOPS
1 OFC RESERVE COMPON DA
2 CG USA SEC AGCY ARL HALL STA ATTN AC OF S G1 VA
12 ADMIN DDC ATTN: TCA (HEALY) CAMERON STA ALEX., VA. 22314
1 CO US ARMY MED RES LAB FT KNOX
1 CHF OF R+D DA ATTN CHF TECH + INDSTR LIAISON OFC
1 CO USA CDC MED SERV AGCY FT SAM HOUSTON
2 CG ARMY MED R+D COMD ATTN MEDDH-SR
1 USA BEHAVIOR & SYS RSCH LAB ATTN CRD-AIC ARL VA
1 COMDT USA CBT SURVEIL SCH & TNG CTR ATT ED ADV FT HUACHUCA
1 COMDT USA CBT SURVEIL SCH & TNG CTR ATTN DPG DOC & NEW EQUIP ARIZ
2 TNG & DEVEL DIV ODCSPERS
1 COMDT USA CBT SURVEIL SCH & TNG CTR ATTN 1ST CBT TNG BDE ARIZ
1 CAREER MGT BR ATTN R DETIENNE CAMERON STA ALEX VA
1 USA LIB DIV-TAGO ATTN ASDIRS
1 PRES ARMY MAINT BD FT KNOX
15 CG CONARC ATTN ATIT=RD-RC FT MONROE
2 CG CONARC ATTN LIB FT MONROE
1 CO ARMY CBT DEVEL COMD MILIT POLICE AGY FT GORDON
1 USA ARCTIC TEST CTR CHF INSTR & TEST METH DIV SEATTLE
1 CHF USA AD HRU FT BLISS
1 CHF USA ARMOR HRU FT KNOX
1 CHF USA AVN HRU FT RUCKER
1 CHF USA INF HRU FT BENNING
1 CHF USA TNG CTR HRU PRES OF MONTEREY
2 CG 4TH ARMORED DIV ATTN DCSOT APO NY 09326
1 CO 3D ARMORED CAV REGT FT LEWIS
1 CO 14TH ARMORED CAV REGT ATTN AVN OFCR APO 09146 NY
10 CO 1ST BN 63RD ARMOR 1ST INF DIV ATTN S3 FT RILEY
1 CO 1ST BN 64TH ARMOR 3RD INF DIV ATTN S3 APO NY 09031
8 CO 2ND BN 68TH ARMOR 8TH INF DIV ATTN S3 APO NY 09034
1 CO COMPANY A 3D BN 32D ARMOR 3D ARMORED DIV APO NY
1 CO 3RD BN 37TH ARMOR 4TH ARMORED DIV ATTN S3 APO NY 09066
1 CALIF NG 40TH ARMORED DIV LOS ANGELES ATTN AC OF SG3
1 55TH COMD HQ DIV ARMY NG JACKSONVILLE FLA
1 CG HQ 27TH ARMORED DIV NY AIR NG SYRACUSE
1 TEXAS NG 49TH ARMORED DIV DALLAS
3 CG ARMY ARMOR CTR FT KNOX ATTN G3 AIRKGT
1 CG 3RD INF DIV ATTN ACOFS G3 APO NY 09036
1 CG 7TH INF DIV ATT ACOFS G2 APO SAN FRAN 96207
1 CG 8TH INF DIV ATTN ACOFS G2 APO NY 09111
3 CG 4TH INF DIV (MECH) & FT CARSON ATTN ACOFS G3
1 DA HQS FT CARSON & HQS 4TH INF DIV (MECH) ATT MAJ HARRIS
3 CG 82ND ABN INF DIV ATTN ACOFS G3 FT BRAGG
1 CG XVIII ABN CORPS ATTN ACOFS G3 FT BRAGG

1 CO 197TH INF BRGD FT BENNING ATTN S3
1 CO 1ST BN (REINF) ATTN S3 FT MYER
7 CO 3RD BN 6TH INF REGT ATTN S3 APO NY 09742
1 CO 171ST INF BDE ATTN S3 APO SEATTLE 98731
1 CO 2ND BN 15TH INF 3RD INF DIV ATTN S3 APO NY [illegible]
5 CG 1ST INF DIV ATTN ACOFS G3 FT RILEY
4 CO 1ST BN (MECH) 52ND INF 198TH INF BDE ATTN S3 APO SAN FRAN 96219
1 CO 4TH BN (MECH) 54TH INF ATTN S3 FT KNOX
1 CO USA PARTIC GP USN TNG DEVICE CTR FLA
2 CONSOL RES GP 7TH PSYOP GP APO 96248 SAN FRAN
2 DA OFC OF ASST CHF OF STAFF FOR COMM-ELCT ATTN CETS-6 WASH
1 CG MILIT DIST OF WASHINGTON
2 DA USA ADV GP (ARNGUS) RALEIGH NC
1 USA RECRUITING COMD HAMPTON VA
1 DIR ARMY LIB PENTAGON
1 STRATEGIC PLANNING GP CORPS OF ENGNR ARMY MAP SERV
1 CHF OF MILIT HIST DA ATTN GEN REF BR
1 CO USA 10TH SPEC FORCES GP FT DEVENS
1 CO 24TH ARTY GP (AD) ATTN S3 RI
1 CG 31ST ARTY BDE AD ATTN S3 PA
1 CO 49TH ARTY GP AD ATTN S3 FT LAWTON
2 HQS 4TH BN 59TH ARTY REGT ATTN S3 NORFOLK
1 CO 28TH ARTY GP AD ATTN S3 SELFRIDGE AFB
1 HQS 45TH ARTY BDE AD ATTN S3 ARL HTS ILL
1 CG 101ST ABN DIV (AIRMOBILE) ATTN ACOFS G3 APO SAN FRAN 96383
1 CG 1ST CAV (AIRMOBILE) ATTN ACOFS G3 APO SAN FRAN 96383
1 US ARMY GEN EQUIP ATTN TECH LIB FT LEE
1 US ARMY TROPIC TEST CTR PO DRAWER 942 ATTN BEHAV SCIEN CZ
1 CO USAFAAC ATTN S3 FT SILL
10 CG III CORPS & FT HOOD ATTN G3 SEC FT HOOD
30 CG 1ST ARMORED DIV ATTN G3 SEC FT HOOD
30 CG 2D ARMORED DIV ATTN G3 SEC FT HOOD
25 CO 13TH SUPT BDE ATTN S3 SEC FT HOOD
1 CG USAFAC & FT SILL ATTN AKPSIGT-TNTN
5 CO III CORPS ARTY ATTN G3 SEC FT SILL
15 CO 1ST AIT BDE ATTN G3 SEC FT BLISS
8 CG USATCI & FT POLK ATTN AKPPC-DCOT
1 RSCH CONTRACTS & GRANTS BR ARO
1 BESD ARO OFC CHF OF R&D WASH DC
1 CHF OF R&D DA ATTN SCI INFO BR RSCH SPT DIV WASH DC
1 CO HQS BN USAFAC & FT SILL ATTN S3
4 CO III CORPS ARTY ATTN S3 FORT SILL
1 CO USRAH ATTN S3 FT SILL
1 CG USAFACFS ATTN AKPSIAG-AS FT SILL
1 EACH PROF OF MILITARY SCI USA ROTC
1 CINC US ATLANTIC FLT CODE 312A USN BASE NORFOLK
1 CDR TNG COMMAND US PACIFIC FLT SAN DIEGO
5 TECH LIB PERS 11B BUR OF NAV PERS ARL ANNEX
3 DIR PERS RES DIV BUR OF NAV PERS
1 TECH LIB BUR OF SHIPS CODE 210L NAVY DEPT
1 ENGNR PSYCHOL BR ONR CODE 455 ATTN ASST HEAD WASH DC
3 CO + DIR NAV TNG DEVICE CTR ORLANDO ATTN TECH LIB
1 CO FLT ANTI-AIR WARFARE TNG SAN DIEGO
1 CO NUCLEAR WPNS TNG CTR PACIFIC US NAV AIR STA SAN DIEGO
2 CO FLT TNG CTR NAV BASE NEWPORT
1 CO FLEET TNG CTR US NAV STA SAN DIEGO
1 CLIN PSYCHOL MENTAL HYGIENE UNIT US NAV ACAD ANNAPOLIS
1 PRES NAV WAR COLL NEWPORT ATTN MAHAN LIB
2 CO & DIR US ATLANTIC FLT ASW TACTICAL NORFOLK
1 CO NUCLEAR WEAPONS TNG CTR ATLANTIC NAV AIR STA NORFOLK
2 CO FLT SONAR SCH KEY WEST
1 CO FLT ANTI-SUB WARFARE SCH SAN DIEGO
1 CHF OF NAVL RSCH PERS & TNG BR (CODE 458) ARL VA
1 CHF OF NAV RES ATTN HEAD GP PSYCHOL BR CODE 452
1 DIR US NAV RES LAB ATTN CODE 5120
1 DIR NAVAL RSCH LAB ATTN LIB CODE 2029 WASH DC
1 CHF OF NAV AIR TNG TNG RES DEPT NAV AIR STA PENSACOLA
1 CO MED FLD RES LAB CAMP LEJEUNE
1 CDR NAV MSL CTR POINT MUGU CALIF ATTN TECH LIB CODE 3022
1 DIR AEROSPACE CREW EQUIP LAB NAV AIR ENGNR CTR PA
1 OIC NAV PERS RES ACTVY SAN DIEGO
1 NAV NEUROPSYCHIAT RES UNIT SAN DIEGO
2 NAVAL MSL CTR (CODE 5342) PT MUGU CALIF
1 DIR PERS RES LAB NAV PERS PROGRAM SUPPORT ACTIVITY WASH NAV YD
1 NAV TNG PERS CTR NAV STA NAV YD ANNEX CODE 93 ATTN LIB WASH
2 COMDT MARINE CORPS HQ MARINE CORPS ATTN CODE AO-1B
1 HQ MARINE CORPS ATTN AX
1 DIR MARINE CORPS EDUC CTR MARINE CORPS SCH QUANTICO
1 DIR MARINE CORPS INST ATTN EVAL UNIT
1 US MARINE CORPS HQS HIST REF LIB ATTN MRS JAQOT
1 CHF OF NAV OPNS OP-01P1
1 CHF OF NAVL OPS OP 037 WASH DC
1 CHF OF NAV OPNS OP-07TL
2 COMDT HQS 8TH NAV DIST ATTN EDUC ADV NEW ORLEANS
1 CHF OF NAV AIR TECH TNG NAV AIR STA MEMPHIS
1 DIR OPS EVAL GRP OFF OF CHF OF NAV OPS OP03EG
2 COMDT PTP COAST GUARD HQ
1 CHF OFCR PERS RES + REVIEW BR COAST GUARD HQ
1 CO US COAST GUARD TNG CTR GOVERNORS ISLAND NY
1 CO US COAST GUARD TNG CTR CAPE MAY NJ
1 CO US COAST GUARD TNG CTR & SUP CTR ALAMEDA CALIF
1 CO US COAST GUARD INST OKLA CITY OKLA
1 CO US COAST GUARD RES TNG CTR YORKTOWN VA
1 SUPT US COAST GUARD ACAD NEW LONDON CONN
1 OPNS ANLS OFC HQ STRATEGIC AIR COMD OFFUTT AFB
1 AIR TNG COMD/XPT RANDOLPH AFB
1 TECH DIR TECH TNG DIV(HRO) AFHRL LOWRY AFB COLO
1 CHF SCI DIV DRCTE SCI + TECH DCS R+D HQ AIR FORCE AFRSTA
1 CHF OF PERS RES BR DRCTE OF CIVILIAN PERS DCS-PERS HQ AIR FORCE
1 CHF ANAL DIV (AFPDPL (R) DIR OF PERSONNEL PLANNING HQS USAF
2 CDR ELEC SYS DIV LG HANSCOM FLD ATTN ESMDA/STOP 36 MASS
1 AFHRL/TT ATTN CAPT W S SELLMAN LOWRY AFB
1 HQ SAMSO (SMSIR) AF UNIT POST OFC LA AFS CALIF
2 MILIT TNG CTR OPS LACKLAND AFB
2 AFHRL (HRT) WRIGHT-PATTERSON AFB

1 AMD AMRH BROOKS AFB TEXAS
1 HQS ATC DCS/TECH TNG (ATTMS) RANDOLPH AFB
1 DIR AIR U LIB MAXWELL AFB ATTN AUL3T-63-253
1 USAFA DIR OF THE LIB USAF ACAD COLO
1 6570TH PERS RES LAB PRA-4 AEROSPACE MED DIV LACKLAND AFB
1 TECH TNG CTR (LMTC/OP-I-L1) LOWRY AFB
2 [illegible] HUMAN RESOURCES LAB BROOKS AFB
1 COMDT USAF SPEC OP SCH (TAC) EGLIN AFB
1 AFHRL (FT) WILLIAMS AFB ARIZ
1 PSYCHOBIOLOGY PROG NATL SCI FOUND
1 DIR NATL SECUR AGY FT GEO G MEADE ATTN TDL
1 DIR NATL SECUR AGY FT GEO G MEADE ATTN DIR OF TNG
3 CIA ATTN CRS/ADD STANDARD DIST
1 SYS EVAL DIV RES DIRECTORATE DOD-DDD PENTAGON
1 DEPT OF STATE BUR OF INTEL + RES EXTERNAL RES STAFF
1 SCI INFO EXCH WASHINGTON
2 CHF MGT & GEN TNG DIV TR 200 FAA WASH DC
1 BUR OF RES & ENGR US POST OFC DEPT ATTN CHF HUMAN FACTORS BR
1 EDUC MEDIA BR OF HEW ATTN T D CLEMENS
1 NAT'L BUR STANDS BEHAV SCI GP ATTN DR D E ERLICK
1 OFC OF INTERNATL TNG PLANNING & EVAL BR AID WASH DC
1 DEPT OF TRANS FAA ACO SEC HQ 610A WASH DC
2 ERIC OF WASH DC
1 CONSOL FED LAW ENFORCEMENT TNG CTR WASH DC
1 SYS DEVEL CORP SANTA MONICA ATTN LIB
2 DUNLAP + ASSOC INC DARIEN ATTN LIB
2 RAC ATTN LIB MCLEAN VA
1 RAND CORP WASHINGTON ATTN LIB
2 ELECT PERS RSCH GP U OF SOUTHERN CALIF
1 COLUMBIA U ELEC RES LABS ATTN TECH EDITOR
1 MITRE CORP BEDFORD MASS ATTN LIB
2 SIMULATION ENGR CORP ATTN DIR OF ENGR FAIRFAX VA
2 LEARNING R&D CTR U OF PITTS ATTN DIR
1 HUMAN SCI RES INC MCLEAN VA
2 TECH INFO CTR ENGNR DATA SERV N AMER AVN INC COLUMBUS O
1 CHRYSLER CORP MSL DIV DETROIT ATTN TECH INFO CTR
1 RAYTHEON SERV CO ATTN LIBN BURLINGTON MASS
1 GEN DYNAMICS POMONA DIV ATTN LIB DIV CALIF
1 OTIS ELEVATOR CO DIV ATTN LIB STAMFORD CONN
1 MGR BIOTECHNOLOGY AEROSPACE SYS DIV MS 8H-25 BOEING CO SEATTLE
1 IDA RSCH & ENG SUPT DIV ARL VA
1 SCI & TECH DIV IDA ARL VA
1 HUGHES AIRCRAFT COMPANY CULVER CITY CALIF
1 DIR CTR FOR RES ON LEARNING + TEACHING U OF MICH
1 EDITOR TNG RES ABSTR AMER SOC OF TNG DIRS U OF TENN
1 DIR CTR FOR RSCH IN SOCIAL SYS KENSINGTON MD
3 CANADIAN JOINT STAFF OFC OF DEF RES MEMBER WASHINGTON
3 CANADIAN ARMY STAFF WASHINGTON ATTN GSO2 TNG
2 ROYAL SWEDISH EMBSY ATTN ARMY ATTACHE
3 AUSTRALIAN NAV ATTACHE EMBSY OF AUSTRALIA WASH DC
1 OFC OF AIR ATTACHE AUSTRALIAN EMBSY ATTN: T.A. NAVGN WASH, D.C.
2 DR B T DODD U OF SHEFFIELD DEPT OF PSYCHOL ENG
1 MENNINGER FOUNDATION TOPEKA
1 AMER INSTS FOR RSCH SILVER SPRING
1 AMER INSTS FOR RSCH ATTN LIBN PA
1 DIR PRIMATE LAB UNIV OF WIS MADISON
3 MATRIX RSCH CO FALLS CHURCH VA
1 EDUC & TNG CONSLT CO LA CALIF
1 DR GEORGE T HAUTY CHMN DEPT OF PSYCHOL U OF DEL
1 VITRO LABS SILVER SPRING MD ATTN LIBN
1 HEAD DEPT OF PSYCHOL UNIV OF SC COLUMBIA
1 TVA PERS STAFF OFCR KNOXVILLE TENN
1 U OF GEORGIA DEPT OF PSYCHOL
1 GE CO WASH D C
1 AMER INST FOR RSCH ATTN LIB PALO ALTO CALIF
1 COLL OF ARTS & SCI U OF MIAMI ATTN L L MCQUITTY
1 ROWLAND + CO HADDONFIELD NJ ATTN PRES
1 OHIO STATE U SCH OF AVN
1 SCI RSCH ASSOC INC DIR OF EVAL CHICAGO ILL
1 AIRCRAFT ARMAMENTS INC COCKEYSVILLE MD
1 DR J B CULLEN DEPT OF SOC & ANTHROP UNIV OF RI
2 OREGON STATE U DEPT OF MILIT SCI ATTN ADJ
1 TUFTS U HUMAN ENGNR INFO + ANLS PROJ
1 AMER PSYCHOL ASSOC WASHINGTON ATTN PSYCHOL ABSTR
1 NO ILL U HEAD DEPT OF PSYCHOL
1 GEORGIA INST OF TECH DIR SCH OF PSYCHOL
1 ENGNR LIB FAIRCHILD HILLER REPUBLIC AVN DIV FARMINGDALE N Y
1 LIFE SCI INC FT WORTH ATTN PRES
1 AMER BEHAV SCI CALIF
1 COLL OF WM + MARY SCH OF EDUC
1 SO ILLINOIS U DEPT OF PSYCHOL
2 ASSOC DIR COC TNG PROG ATLANTA GA
1 WASH MILITARY SYS TECH LIB DIV BETHESDA MD
1 NORTHWESTERN U DEPT OF INDSTR ENGNG
1 DR L TWYFORD NY STATE EDUC DEPT ABSTRACT EDITOR AVCR
1 AEROSPACE SAFETY DIV U OF SOUTHERN CALIF LA
1 MR BRANDON B SMITH RES ASSOC U OF MINN
1 DR V ZACHERT RT 1 GOOD HOPE GA
1 J P LYDON DIR JR ROTC SAN ANTONIO TEXAS
1 DR E FOULKE DEPT OF PSYCH UNIV OF LOUISVILLE
2 CHRYSLER CORP DEF ENGR ATTN DR H BERMAN DETROIT
1 DR S ROSCOE ASSOC DIR FOR RSCH INST OF AVN U OF ILL
1 DR C HELM DEPT EDUC PSYCH CITY U OF NY
1 DR E PERKINS PROF OF PSYCH ST CLOUD STATE COLL MINN
1 MS S AILES ASSOC OF AMER RR WASH DC
1 DR W BEVAN AMER ASSOC FOR ADVMNT OF SCI WASH DC
1 DR W C BIEL U OF SOUTHERN CALIF LA
1 DR C W BRAY BOX 424 QUOGUE LI NY
1 MR J M CHRISTIE PRES RIGGS NATL BANK WASH DC
1 DR C W CLARK VP FOR RSCH RSCH TRIANGLE INST NC
1 GEN H P HARRIS (USA RET)PRES THE CITADEL SC
1 DR L T RADER 1200 ROXWOOD CIR WAYNESBORO VA
1 DR H SHOEMAKER DIR TNG RSCH GP NY
1 A C FURTH SOUTHN PACIFIC CO SAN FRAN
1 U OF MINN DEPT OF INDUST EDUC ATTN R E KUHL

1 VOC-TECH EDUC PROG PLNNG DEV ATTN W STOCK ST PAUL
1 CHF PROCESSING DIV DUKE U LIB
1 U OF CALIF GEN LIB DOCU DEPT
1 FLORIDA STATE U LIB GIFTS + EXCH
1 PSYCHOL LIB HARVARD UNIV CAMBRIDGE
1 U OF ILL LIB SER DEPT
2 U OF KANSAS LIB PERIODICAL DEPT
1 U OF NEBRASKA LIBS ACQ DEPT
1 OHIO STATE U LIBS GIFT + EXCH DIV
1 PENNA STATE U PATTEE LIB DOCU DESK
1 PURDUE U LIBS PERIODICALS CHECKING FILES
1 STANFORD U LIBS DOCU LIB
1 LIBN U OF TEXAS
1 SYRACUSE U LIB SER DIV
1 SERIALS REC UNIV OF MINN MINNEAPOLIS
1 STATE U OF IOWA LIBS SER ACQ
1 NO CAROLINA STATE COLL DH HILL LIB

2 BOSTON U LIBS ACQ DIV
1 U OF MICH LIBS SER DIV
1 BROWN U LIB
1 COLUMBIA U LIBS DOCU ACQ
1 DIR JOINT U LIBS NASHVILLE
2 LIB GEO WASH UNIV ATTN SPEC COLL DEPT WASH DC
2 LIB OF CONGRESS CHF OF EXCH + GIFT DIV
1 U OF PGH DOCU LIBN
1 CATHOLIC U LIB EDUC & PSYCHOL LIB WASH DC
1 U OF KY MARGARET I KING LIB
1 SO ILL U ATTN LIBN SER DEPT
1 KANSAS STATE U FARRELL LIB
1 BRIGHAM YOUNG U LIB SER SECT
1 U OF LOUISVILLE LIB BELKNAP CAMPUS
1 GEORGETOWN U LIB SER DEPT WASH DC
1 LIBS COLO STATE U ATTN DOC LIBN FT COLLINS